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INTERNATIONAL PATENT PROTECTION.

It is interesting and encouraging to note that amidst all the blockading and filibustering in Washington over necessary legislation, the Senate has passed the House bill to render effective the provisions of the additional act of the International Convention for the Protection of Industrial Property. It amends the application of the patent laws so as to make the practice in the United States conform to that of the international convention. This is a decided step forward in creating uniformity of patent law and the extension of international patent protection; and we have no doubt that President Roosevelt will find the measure worthy of his signature. The ultimate aim of such work must be, however, to effect something similar to international postage. It will be remembered that not long since we quoted in these pages the admirable argument of Mr. John S. Seymour, United States Commissioner of Patents under President Cleveland, in favor of a universal patent examination system, which should practically validate a good patent everywhere throughout the civilized world and economize in the cost of securing and maintaining the rights of worthy inventors. Mr. Seymour may seem to some people a little in advance of his time, but civilization means nothing if it does not mean the execution of such ideas as his.

THE ST. LOUIS EXPOSITION.

Elsewhere we print an article which gives a gratifying account of progress on the St. Louis Exposition. From this it appears that the Electricity Building—which promises to be the architectural *chef d'œuvre* of the Exposition—is almost completed in its main structure, and that applications for space thus far made indicate that instead of there being any surplus at the time when the procrastinator usually wakes up, a problem will be encountered in supplying the demands of the early-comers. An admirable feature of the plans for the show proper is that which provides for working exhibits which will not only be of the highest interest to the technical visitor, but will also appeal to the layman. In this respect the Exposition promises to set a precedent which will give a new impetus to the international exposition idea which, owing to the sameness of such shows in recent years, was beginning to lose its erstwhile potency. The electrical arrangements decided upon show throughout a grasp of the situation highly creditable to Prof. Goldsborough and the authorities who are upholding his hands.

THE BRUSH STORAGE BATTERY PATENT.

It is now almost twenty-two years since Sir William Thomson sensationally introduced the storage battery to the world by remarking dramatically at a scientific gathering that a small box he held in his hand contained one million foot-pounds of stored energy. The statement caught the fancy of the newspapers of the world, and for a long period the storage battery monopolized attention to the exclusion of other current electrical developments. Highly capitalized companies were everywhere formed to exploit the new marvel, inventors the world over turned attention to its improvement, and patent offices were overwhelmed with applications based upon their work. Four years later the electrical public was startled by the issue of a patent to Charles F. Brush, which not only covered the whole previous art, excluding Planté cells, but also any improvements to the composite plate that might be made during its life of seventeen years—which only ended last week. Though the very principle of the storage battery as developed from the begin-

ning of last century involved a metallic structure, the Brush patent of March 3, 1886, covered absolutely the use of a metallic support in connection with any improvement offered, which claim practically closed the art to all except the owners of the patent, and rendered subsidiary to it the many hundreds of patents which irrepressible inventors nevertheless insisted upon taking out during its life. It is true that in suits which immediately followed the issue of the patent, it was established that Brush had anticipated Faure in the conception of the composite plate, but the intrinsic merit of the specific invention which the patent covered seems to fall very far short of having justified for a period of seventeen years the complete monopolization of an art well developed before its issue. The expiration of the Brush patent appears to remove the last obstacle to the general manufacture of storage batteries. Whether this means much or little commercially cannot be safely predicted; for in the past, in some cases the lapsing of fundamental patents has been followed by important developments, as has been witnessed in the telephone art, while in other cases not much headway has been made in free competition with the interest which during the life of its patents had taken advantage of the opportunity afforded to place itself in a position to meet such competition. Without doubt, however, a careful investigation of the many hundreds of storage battery patents issued since 1881 and dormant since 1886 would reveal improvements of merit, and particularly in details that could be applied to present types.

AXLE-CAR LIGHTING.

The three papers read last week before the American Institute of Electrical Engineers, on the subject of railroad car electric lighting by axle-driven generators, are of interest in pointing out the divergence in methods employed, notwithstanding the fact that electric car-lighting was one of the earliest applications of the incandescent lamp. It is to be regretted, however, that the budget of papers did not include one or more on the system of train lighting now most largely in use—that employing an engine generating set taking steam from the locomotive. The problem involved in train lighting is very easily enunciated. A railroad car is propelled by a steam-engine, with the occasional aid of gravitation. The rotation of the car-axles furnishes the motive power for a dynamo. The dynamo supplies the lamps on the car, and also charges a storage battery for service during halts and stoppages. On paper, nothing could be simpler.

When, however, the actual problem in steel and copper is confronted, it proves to be most tantalizing and harrassing. The axle of a railroad car is sacred to a railroad man and "taboo." Its integrity must not be interfered with by the lighting engineer who wants to harness to it his dynamo. The dynamo must be supported from the car truck, and the distance between the dynamo shaft and the driving car-axle is, therefore, subject to variation, and often to oscillatory variation. The dynamo and its connection with the car axle is hidden under the truck, where no man wants to look at it, and where no man does look at it unless he is obliged to, and then in a cramped, crouching attitude of defiance; so that self-reliance and self-lubrication are qualities that are of the highest importance to the dynamo and gearing—qualities that have to be imparted thereto at birth, as they cannot be satisfactorily added afterwards.

The dynamo is driven at continually varying speeds. The speed at which it must take up its load and march means some 18 miles-per-hour of the car-wheel tread. Yet if the cars runs at five times this speed, the dynamo must not only work safely, but the lamps must not suspect that there is anything unusual happening. There must be hand switches to turn on the lamps in the car. There must be automatic switches to cut in the storage battery when the dynamo throws down its task at slow speed, and also to cut in the dynamo when the latter comes up to the speed at which it again lays its shoulder to the wheel. If anything goes wrong with these switches, it may be at a place where no man within a hundred miles knows how to rectify their behavior. The man actually in charge of the plant on the car may be fatally charged with the mission of smashing and mishandling whatever mechanism comes to his hand. So this mechanism must be fool-proof, water-proof, snow-proof, dust-proof and yet do faithful service withal. The man who can design a reasonably good axle-driven train-lighting system is a good engineer; but the man who can stand by and bring it to perfection and satisfactory service is either in league with the powers of darkness, or else deserves an aureola. One of the systems described before the Institute uses 32-volt lamps. Another uses 64-volt lamps. In some systems 100-volt lamps are employed. Again, one system uses a dynamo, a motor and a "bucker," with four armature windings and commutators, divided among the three. Another system employs a motor-driven shunt-rheostat controller, and the third system, as described in its paper, is almost absolute perfection—only we are not told what it is.

HIGH TENSION CABLES.

Mr. Floy's paper in the present issue is a comforting, if brief account of high voltage underground work. By many engineers the transmission of energy at high voltage underground is considered a *dernier resort*, never to be undertaken save under stress of absolute necessity, and then for the smallest possible distance and with some trepidation. Not that it is impossible to get good cables even for 25,000 volts or more, and so to install them that they will be fairly enduring; but it is held that this underground work is enormously expensive if well done, and that generally it is not necessary. Going underground from choice or unless forced there by the stern hand of the law is pretty nearly unthinkable to the average American engineer, who is not so much deterred by the cost nor the short life of the cables, as by the eternal uncertainty as to the risks. For, he reasons, you cannot tell when a cable is likely to go, nor at what spot it is in danger. It may test out excellently well month after month, and then go up without warning some day and leave the plan paralyzed, unless duplicate cables are already in place, for many hours or even days; and interruption of service is a calamity not easily to be over-estimated in its material and moral effect.

Even assuming this standpoint, in some cases local conditions make underground cables, even for high voltage, a necessity, and to the credit of our cable manufacturers be it said that they have turned out, as Mr. Floy clearly shows, some exceedingly good material. In fact, the high voltage cables are as a rule given a factor of safety rather more considerable than in the ordinary distribution cables for moderate voltage, and they do, therefore, better than one would naturally expect. The exact nature of the insulating material is in this instance less important than the thoroughness with which it is protected from moisture and mechanical injury. It is not an excessively difficult matter to find insulation that when firm and dry will stand the highest voltages yet in commercial use, but it must be confessed that to preserve its integrity is quite another matter. However insulated, high voltage cables should be installed in the dryest of conduits and with the minimum possible number of joints. Joints are always danger spots in any cable, and if conditions permit it is wise to arrange the conduits so that rather long runs can be made, and to plan for extraordinary drainage facilities. As to the particular nature of the insulation, every system has its earnest advocates, and every system has its failings. Rubber has been the canonical insulation for a long time, but some highly successful cables have been made without it, and in the present scarcity of rubber there is a strong incentive to try something else. Rubber is a

magnificent insulator when of first-rate quality, but it is chemically somewhat unstable, and it is a good sign to see other materials coming into use, particularly when of lower specific inductive capacity.

In spite of the relatively small trouble that seems so far to have arisen from resonance and the particular case of it known as surging, it still is a menace of a very serious character, and is a commoner cause of trouble than is generally supposed. Even on overhead lines it often breaks loose with very sensational results, and we have known of instances where cables have given continual trouble from this cause until proper remedies were applied. Static capacity is a thing to be dreaded from this point of view, and even on overhead lines it steadily tends to unpleasantly large values. But danger comes generally not from the normal relations between capacity and inductance but from the abnormal ones. The inductance of a system is not a constant quantity and one may easily get into danger without suspecting it. Hence, when underground cables are included in the system they need watching with the possibilities of resonance in mind. As to the lack of danger from lightning to which Mr. Floy refers, we recall the fact that in 1898 three submarine mines near Hampton Roads were exploded during a single thunderstorm by, if we remember aright, the same flash of lightning. Of course, the conditions are not quite parallel, but while underground lines surely are safer from certain kinds of lightning effects than overhead lines, it is not safe to assume that there is complete security. Extended experience alone can decide as to the strength of the position of those who hold that while a well-planned underground line is less liable to minor accidents than an ordinary overhead one it runs greater risk of serious and protracted interruptions of service. For assurance, in putting down an underground high-tension line, not only should the very best materials be employed, but for greatest security the line should be in duplicate and so separated that even in the man-holes the failure and destruction of a cable cannot involve its neighbors. An entirely separate conduit from the low-tension lines should be used in large installations whenever feasible, so as still further to remove the likelihood of complete disability.

THE PROPOSED NEW YORK STATE ELECTRICAL LABORATORY.

The report of the Commission, consisting of Messrs. Bond, Steinmetz and Buck, appointed to investigate the necessity of establishing a State Laboratory, has been issued in pamphlet form. The report commences by stating that according to the best available information, the capital invested in New York State in electric railroads, light and power stations, telegraph and telephone systems, amounts to nearly one and one-half billions of dollars; while the capital invested in the manufacture of electrical apparatus is, moreover, about one-seventh of the above, or over two hundred millions of dollars. Fourteen reasons are then assigned for the utility which a state laboratory may possess. The plant recommended in the report consists of a 500-hp power-house, a storage building with an elevator, an electrochemical building, a machinery building, and an administration building with a lecture hall. The estimate for these buildings is about $80,000, which seems very low. The estimate for equipment is about $180,000, or about 2¼ times the building allowance. Ten thousand dollars more for superintendence and etc., brings the total estimate to $275,000. The report concludes by recommending that this sum be appropriated, that the selection of a site and nomination of a director be confided to the Commission, as well as the preparation of a plan of control. A circular letter is appended which was issued to a number of persons and corporations in and out of New York State. About fifty replies to this circular are printed. The consensus of opinion thus elicited appears to be in favor of a state electrical laboratory properly conducted, though a number criticize one or more features of the proposed plan and scope. As the adverse action of the American Institute of Electrical Engineers had not been taken when the report was rendered, naturally no mention of it appears.

It seems that if the laboratory is conducted in co-operation with the National Bureau of Standards at Washington, some useful results might be secured therefrom. Any attempt, however, to set up a laboratory in a State usurping the functions of the National Bureau of Standards would be a deplorable catastrophe to the progress of electrical science in the country at large. It is open to doubt whether there will be a real necessity for the New York State laboratory as soon as the National Bureau at Washington is completed and also in view of commercial testing establishments already existing. Moreover, it has been announced that the former proposes to foster the establishment of calibration bureaus in the electrical engineering departments of our universities to cater to local needs. Indeed, the report is far from convincing on this point. A section entitled "Misconceptions Corrected" is devoted to a reply to the criticism which has been freely directed against the establishment of the proposed laboratory, and in this it is stated that all the Commission proposes is the establishment of the laboratory for (1) the calibration of all forms of electrical meters and other electrical apparatus and appliances. (2) Experimental tests which may be called for by the courts, by municipalities or by individuals, for impartial evidence on disputed questions of fact. (3) Continual investigation and experiment with a view to the development of electrical science and to further application of electrical power to useful ends. It would appear that (1) and (3) would in part involve conflict with the functions of the National Standardization Bureau; that (3) in part would cover ground that the Carnegie Institute, with its annual fund of a quarter of a million for the purposes of investigation, has preempted; and that (1) would in part place the State in competition with existing commercial testing bureaus.

But to our mind, the greatest objection to the project is the precedent it would set. In some states the electrical hanger-on with a political pull would most surely be inspired to become perniciously active in working for the establishment of a similar institution in his state, to the directorship of which he would naturally aspire; with state laboratories generally established, each with its own methods of work, there could scarcely fail to be cases in which apparatus pronounced entirely satisfactory in one state would be found wanting in another, thus involving trouble and annoyance to manufacturers; and in states where the municipal ownership feeling is strong, the control of the state laboratory would inevitably become a political question, as witness the strenuous efforts made for the control for ulterior purposes of the State Railroad Commissions where such exist. If, however, the project is viewed with favor at Albany and meets with realization, there is every assurance that the laboratory, so long as its work is supervised by gentlemen of the standing and ability of those who constitute the present commission, will make a return for the money expended; for the more work that is done in experimental science, the more rapid should be the advance of engineering, and of national wealth consequent upon engineering. The agricultural experiment stations, more than fifty in number, which are scattered over the States are operated in conjunction with a central bureau in Washington, and it is to this co-operation that at least part of the excellent results of the system are attributable. It is equally important that a state laboratory issuing physical standards should be co-operated with the central and National Bureau of Standard at Washington, otherwise we may find that a multiplication of laboratories introduces confusion and a multiplication of different standards The report assures that such co-operation is part of the present plan —but who will answer for the future proper conduct of the institution?

Tesla Split-Phase Patent Invalidated.

The United States Circuit Court of Appeals, sitting in New York, handed down a decision last week, invalidating two Tesla split-phase patents issued December 26, 1893. These are the same patents which were involved in the Ohio fan motor suit, in which case they were sustained (April, 1902) on appeal, against the defence that the patents were anticipated by an earlier patent granted to the same inventor. In June, 1901, Judge Lacombe in the present case sustained the patents, and is thus reversed on appeal. The defence in the lower court was no infringement, the grounds being taken that the patents merely covered motors and did not apply to meters; and that the meter in suit did not involve the use of a rotary field. The suit was instituted against the Catskill Illuminating & Power Company, but was directed at the Scheefer meter, manufactured by the Diamond Meter Company, of Perior, Ill.

The ground upon which the patents have been invalidated is that the principle which they covered was disclosed in a report of a lecture delivered by Prof. Galileo Ferraris, in Turin, March 16, 1888, and printed in the Italian journal, *L'Electricitta,* April 22, 1888. The applications for the Tesla patent were filed Dec. 8, 1888, and the court held that the complainant failed to establish that Tesla had conceived the invention prior to the Ferraris publication. The opinion was written by Judge Townsend, Judges Coxe and Wallace concurring.

The opinion, after setting forth the facts of the Ferraris disclosure, is occupied principally with a discussion of the value of the testimony offered by two witnesses for the complainant, which supported the contention that the conception of Tesla antedated this disclosure. The court held that one witness, owing to the length of time that had elapsed, must have confused dates, and that it was in 1888 and not 1887 when Tesla explained to him the principles of the split-phase motor. As evidence of this it is adduced that in 1888 Tesla spent nearly two weeks at the factory of the Mather Electric Company explaining his new alternating-current motor inventions with a view to interesting that company in their development and manufacture; that one of the objections made to their operation was the fact that they required a special generator and extra wires, but that Tesla did not then claim he had made any invention whereby two currents of different phase could be derived from a single source. Moreover, the second witness above referred to, who was Tesla's patent attorney, has testified that up to a few days after April 8, 1888, Tesla had never intimated that his invention of the rotary field motor could be practiced by any means which did not involve the use of two independent circuits from the generator to the motor.

After discussing further testimony of this latter witness, the court concluded that it relates to events which occurred twelve years ago concerning which he had no means for refreshing his recollection except a diary which was not produced, having been lost several years ago. The opinion in concluding states that in view of the character of the testimony of this witness it was incumbent upon the complainant to furnish additional evidence in order to remove its uncertainties, or to account for its failure so to do. This was not done, nor was Tesla summoned to testify in the matter. The Court therefore felt constrained to hold that invention by Tesla prior to April 22, 1888, has not been proved. The decree was reversed with costs, with instructions to the court below to dismiss the bill with costs.

Union College Electrical Course.

The current issue of *Concordiensis,* of Union College, contains an article by Mr. C. P. Steinmetz on the new electrical course of that institution, of which he is director. Mr. Steinmetz states that the reasons which led him to undertake the organization and direction of the electrical engineering course of Union College were that the conditions at Schenectady are unusually favorable for an electrical engineering school superior to any, due to the old and well-established reputation of the college in engineering education and the proximity and favorable disposition of the largest electrical manufacturing company, which affords the students chances to see and familiarize themselves with apparatus and receive information which no other electrical engineering school could offer.

While the electrical laboratory, after being refitted, will not be as large as the laboratories of some other colleges, after all a large and well-fitted laboratory, however desirable and useful, is usually vastly overrated in its importance. It is not the laboratory which makes the success of an engineering school but the teaching force, directly by their work and indirectly by the educational policy of the institution inspired by their co-operation. After all, in the General Electric Company's works, which are open to the students, Union College has an electrical laboratory vastly greater than the electrical laboratories of all the colleges of the world combined.

Regarding the educational policy of an engineering school, the opinions are divided between those who desire to make the college a training school for specialists and those who endeavor to give a general all-around education leading up to specialization in the art chosen by the students. Theoretically the former is correct and four years by no means too long a time to be devoted to engineering studies. However, the first condition which the college should fulfill is to turn out educated men and not mere trained artisans. To devote the total college course to engineering studies, therefore, pre-supposes that the general culture studies required for any educated man are completed when entering the college. But neither graduation from the modern high school nor the entrance conditions of the college comprise a sufficiency of general culture studies, and therefore a part of the college year must be devoted to them, if graduation from the college should be a qualification of educated men. This broad educational policy has always been a feature of Union College and will remain so, and it is hoped that with the complete establishment of the new course it will be feasible to increase the amount of general culture studies and at the same time increase the special engineering studies while still decreasing the work which is required from the students, by the increased efficiency resulting from the increased teaching force.

The first two years of the courses are essentially devoted to general culture studies, as languages, literature, logic and composition, history of man and natural history, biology, etc. Only such general engineering studies as mathematics and mechanics, which must be familiar before engineering work can be undertaken, are included in the first two years.

The last two years are devoted essentially to special engineering studies. The foundation of electrical engineering is mechanical engineering, and while a young electrical engineer cannot be expected to be fully familiar with all branches of electrical engineering, he must be familiar with the fundamental principles of mechanical engineering. Hence the junior year will be largely devoted to mechanical engineering, as experimental and theoretical mechanics, hydraulics and hydraulic machinery, as turbines and their design, steam machinery, as steam engines and their design, locomotives, gas engines and thermodynamics, etc.

The senior year and a part of the junior year will be devoted to electrical engineering. The complete course will be published shortly in the university catalogue, so it may be sufficient now to say that it will give a thorough grounding in the fundamental principles and their application to all branches of electrical engineering, such as will enable the graduate rapidly to acquire the practical experience necessary to electrical engineering success.

A post-graduate course in electrical engineering has been established, which when completely organized will give advanced instructions, comprising many subjects which, while of fundamental importance in the modern development of electrical engineering, are not taught by any college, hardly not even published yet. It is such knowledge which establishes engineering reputations. It is not sufficient for an electrical engineer who desires to reach high positions to be able to solve ninety-nine out of one hundred problems which he meets in practice, but it is the solution of the one hundredth problem, where everybody else fails, which establishes the reputation of the engineer and raises him to positions where he can leave the solution of the other ninety-nine problems to his subordinates.

Secretary Root and the Metric System.

Secretary of War Root in a letter acknowledging receipt of resolutions adopted by the Paris Chamber of Commerce, favoring a metric system, said that he considers the universal adoption of the system as inevitable within a short time, and added that it would have been adopted before but for the habit attached to the old system.

An Interurban Road With Hooded Third Rail.

A STRIKING advance in third-rail methods of operation has been made by the Wilkesbarre & Hazleton Railroad, an interurban electric system occupying a territory in Pennsylvania all to itself, and flanked by the steam lines of the Pennsylvania and the Lehigh Valley systems. The map shown herewith indicates clearly the region and the respective routes. The intercourse between Hazleton and Wilkesbarre, even under the old conditions, is large. The distance between the railway terminals in the two cities by the railways named is, respectively, 50.4 and 49.6 miles. The Pennsylvania runs four trains a day in each direction, while the Lehigh Valley provides six trains in one direction and five in the other. The new electric line is 26.2 miles long between points of junction with the local electric railways in Wilkesbarre and Hazleton. By the existing steam roads, two hours are required to make the trip between the two cities. At the same average speed, the Wilkesbarre & Hazleton Railway would carry passengers in about seventy minutes, but this running time can be materially cut down, and it is proposed to operate regular express trains between the terminal points named in one hour. The speed ordinances governing the movement of cars on the streets of the respective cities leave only forty minutes of the sixty to cover the distance over a private right of way between the two city limits. Owing to the character of country traversed and the difference of 1,200 feet in the altitude of the terminal points, it

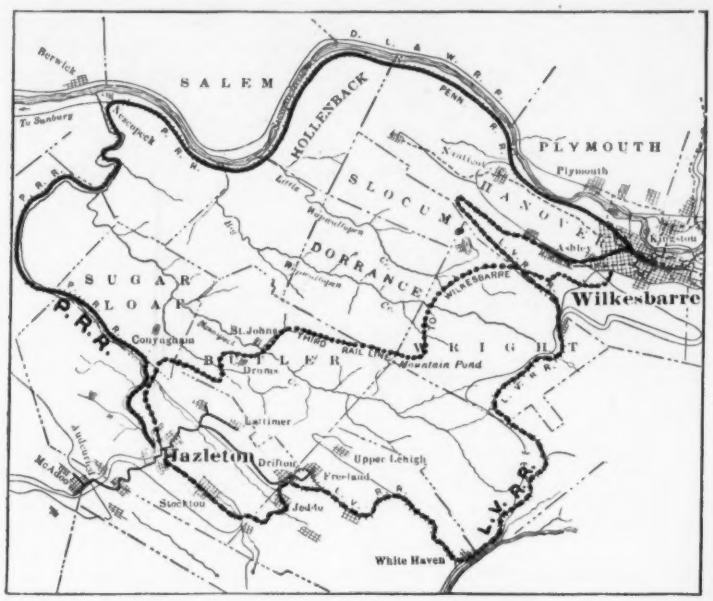


FIG. 1.—MAP OF ROUTE OF THIRD-RAIL ROAD.

became a serious problem to select a route and establish a line entirely free of heavy grades and sharp curves. A private right of way, 60 ft. wide and fenced in on both sides, was acquired, and throughout the entire line there is not a grade exceeding 3 per cent., and only one curve of 18°. The grade thus established necessitated some bold engineering, heavy fills, deep rock cuts, and driving a tunnel 2,600 ft. long through Penobscot Mountain, about 600 ft. below the summit and through solid rock. The eliminations of grade crossings of all kinds was also determined upon, in order that high speed operation might be adopted with safety. This involved the construction of thirty-three highway crossing bridges, and railroad bridges over streams of various sizes, all of these structures being of concrete. The roadbed also includes two large bridges of granite masonry, one of the stone arch type and the other of girder form supported by high masonry piers. The roadbed construction throughout this system has received very close attention, and in some respects marks a distinctive advance among interurban electric properties. The track rail is a Boston & Albany section, 95 pounds to the yard, laid on 8-ft. ties, spaced to 24-in. centers. Nine-ft. ties are used for every fifth tie, where insulators support the contact rail. At present the ties are laid on a bed of cinders, and this will be continued for a year or more, and then a top dressing of broken stone 10½ in. high will be added, the cinders forming a cushion between.

The contact rail is a notable departure from common practice up to the present time, as it is protected from sleet and snow by a 2-in. x 6-in. pine plank held directly over the rail. Already this protection has demonstrated its usefulness, for during the severe sleet and snow storms of December, the cars operated with perfect ease. The added element of personal safety is also a very great factor. This guard plank is supported by oak posts spaced every 8 ft. and both guard and rail are carried by unglazed vitrified clay insulators, furnished by the Ohio Brass Company and spaced every 10 ft. To prevent creeping the fish plates are left moderately loose and an anchoring insulator is placed in each rail midway between joints. The contact rails are 60 ft. long and weigh 80 pounds to the yard. They are of special composition embodying high conductivity. Both

FIG. 2.—VIEW OF PROTECTED THIRD RAIL.

contact rails and track rails are bonded with Chase-Shawmut soldered bonds. The bonds have been applied for over six months and the great shock due to heavy steam locomotives and freight cars passing over the line during the entire construction period has not produced thus far the least indication of breaking away.

The application of the soldered bond necessarily involved a departure from the usual method employed in laying track where protected bonds are used. The bond is under the foot of the rail, and to facilitate the work it became necessary to turn the rail bottom side up. As the track men had only spiked the rails center and joints this was easily done by drawing the inside spikes for a length of about 20 rails, depending on the local degree of curvature in the

FIG. 3.—A GRADE ON THE MOUNTAIN SIDE.

track. The joints were then surfaced, bond applied and eight men with a few short bars could return the rail to its normal position. The spikers in this work followed the bonders rather than the railmen, thus avoiding delay and keeping the spikers busy.

The train schedule to be inaugurated consists of an hourly express service and a local every hour and a half. Six Brill combined coaches have been provided to perform this work, and each consists of a passenger and baggage compartment, the former seating 38 passengers. The baggage compartment is also provided with seats for smokers. The seats fold up when not in use. The car is 51 ft. in

length over all and 9 ft. 6 in. in width. Loading steps are provided at only one side of each platform. The opposite side is used for a motorman's cab. The equipment of the car consists of a General Electric motor attached to each of the four axles. These motors are practically the same as those used on the Manhattan Elevated

FIG. 4.—STONE BRIDGE.

road in New York, and are governed by the Sprague multiple-unit automatic control as embodied in the contactor system. The management expects that the traffic will soon warrant the operation of trains of several cars, and for this reason introduced this system of control. Westinghouse automatic air brakes are used, and the customary

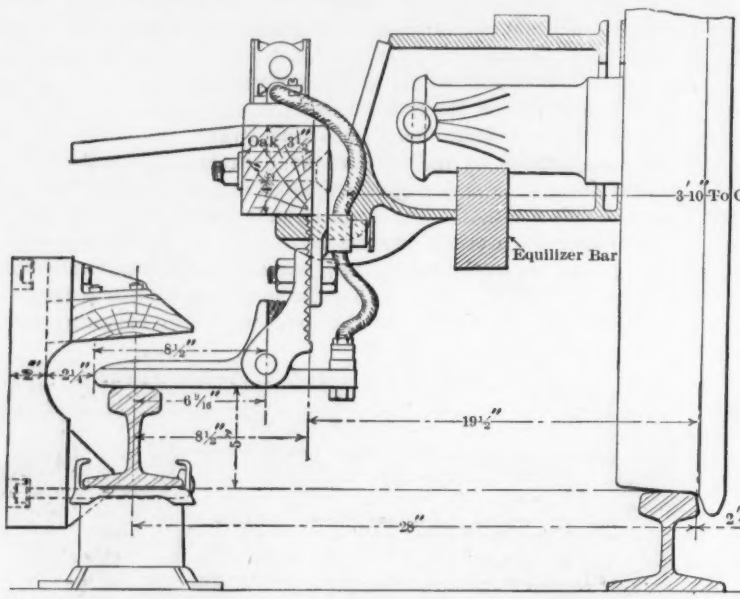


FIG. 5.—DETAILS OF THIRD RAIL, SHOE, ETC.

hand brake is attached in the usual manner. An additional independent foundation hand brake equipment has been applied from the brake shoe up, which is designed to permit of the ready application of the Newell electric brake. The cars are furnished with an air signal system whereby the conductor at any part of a long train may signal the operator at the head, as is now done in steam passenger service.

Another new feature is the contact shoes of special design for use with the protected third rail, the details of which are also shown herewith. Trolley poles are also provided on these cars for use on the city traction systems over which they operate, and the switch governing the connections to trolley and shoe is designed to permit the change being made on a grade without losing contact.

The design of the contact shoes has been worked out by Mr. W. B. Potter, of the General Electric Company, and the method of protecting the third rail is, in a general way, similar to that recently erected on the experimental track of the General Electric Company at Schenectady.

A telephone system is installed which includes a special portable outfit in each car, and plug-in boxes are placed every quarter of a mile along the line. The telephone line is No. 10 hard-drawn copper wire run on wooden brackets and placed 3 ft. below the cross arm carrying the high-tension line, transposed to meet requirements. Heavy gongs are placed at each siding in order that cars passing over the line can be reached by signal from the office. The entire telephone equipment was furnished by the Wilhelm Manufacturing Company.

The power house and sub-station electrical equipment is of standard Westinghouse make throughout, with three-phase generators and Harrisburg and Brown-Fitchburg engines. One of the most interesting features of the plant is the portable sub-station, which consists of an equipment similar to that in the permanent sub-station and is installed in a car especially designed for this purpose, so that it may be shifted to any part of the system where the demands are unusually heavy, as, for instance, in the neighborhood of Triangular Lake during the excursion and picnic season. The length of car over sheathing is 36 ft., and the width over posts is 9 ft. 6 in. The roof can be removed in one piece, like that of a box car, to permit the placing of large and heavy machinery that can best be handled by cranes. Eight large eye-bolts, set in blocks secured to the rafters and top plate of the monitor deck, facilitate the hoisting process. Every alternate rafter is re-inforced with angle iron and all parts of the roof are made extra strong to withstand the stress of moving. Brill trucks are employed. The rotary converter on board is placed directly over the forward trucks, and the three transformers at the other end of the car over the rear trucks, with the switchboard between. The total weight of the equipment is about 51,000 pounds. The car is not equipped with motors, as it can readily be attached as a trailer to a regular passenger car and hauled to any part of the line when it is needed. As already mentioned, the apparatus is similar to the equipment in the sub-station. A slight variation exists

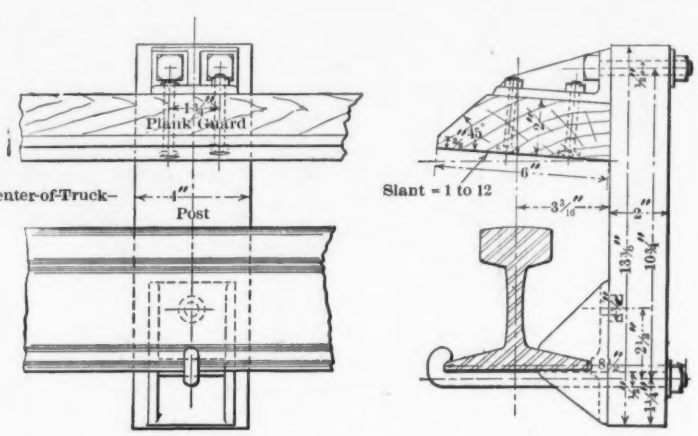


FIG. 6.—PLAN AND CROSS SECTION OF THIRD-RAIL HOOD.

in the connection of the high-tension side of the transformers to the line from those found in the power house and sub-station. In the latter the individual leads from a transformer are connected by means of bayonet switches so that a single transformer may be taken out of service by pulling two switches. In this sub-station car sufficient room did not exist to put on the bayonet switches and the three transformers are supplied with solid connections. The transformer cases are made very high to prevent oil running out on the floor of the car. Long poles are provided to hook connection on to the transmission line at any point alongside of the track. Bayonet switches complete the connection to the car and an oil-break switch

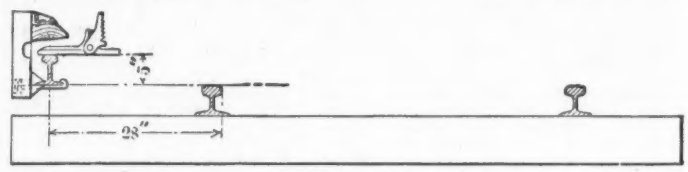


FIG. 7.—RELATIVE POSITIONS OF THIRD RAIL AND ROAD BED.

furnishes a means of opening or closing the connection between the transformers and the high-tension line.

A great deal of credit is due to the enterprise of President A. Markle, of the Wilkesbarre & Hazleton Railway Company, who developed the project, and has given the closest personal attention to the building and equipment of the road. Mr. L. B. Stillwell, who

is consulting engineer for the company, designed the entire plant and the road was built under his direction. He was represented during the construction period by J. E. Wallace, the construction engineer. C. A. B. Houck, chief electrician for the traction company, was associated with Mr. Wallace in the work. A great deal of interest and importance attaches to Mr. Stillwell's use of the hooded third rail and its application in other work may follow its satisfactory test this winter.

A Hydro-Electric Power Plant in Newfoundland.

BY EARL E. BOARDWAY.

ON the bleak east coast of Newfoundland nestling in one of the numerous fiords that make the coast line of this island so ragged, wild and picturesque, is the little fishing village of Petty Harbor, eight miles south of St. John's. From some small lakes back in the mountains comes tumbling down over the rocks a small stream to empty into this arm of the sea. To R. G. Reid, of Montreal, who owns and operates the entire railroad system of 638 miles on the island, besides a fleet of eight coastwise steamers, it appeared that this little stream could be turned to useful account if its power could be harnessed and carried to the capital and metropolis of the island, St. John's, to run the street cars and supply light to the city, besides furnishing power to operate other industries. Accordingly, in 1898, after making the surveys, Mr. G. H. Massey, the chief engineer of the Reid interests, began the construction of a wooden dam and flume about a mile back in the hills, while A. C. Rice, consulting engineer, of Worcester, Mass., was making the plans for the power station.

The power house was located at the mouth of the stream, with its tailrace about down to tide water, as the wooden flume is carried along the steep hillside to a point opposite the power house, where a steel penstock, six and one-half feet in diameter, drops over the cliff, at an angle of 45°, to the power house 185 ft. below. The flume is built of 12 x 12 timbers and lined with three-inch plank, the inside dimensions being 13½ ft. wide and 13 ft. deep. At its upper end a wooden crib dam 15 ft. high thrown across the stream backs up the water and diverts it to one side through the racks and gate house into the flume.

The flume then starts upon its tortuous path, winding in and out along the steep, rocky hillside for a mile, but as it approaches the power house the rocks become so precipitous, projecting out to form a ridge, that it was necessary to tunnel through this ridge for 250 ft. At the lower end of the flume it widens out into a small forebay

FIG. 1.—POWER HOUSE, FLUME AND PIPE LINE.

with water racks and head gates to form a suitable entrance to the steel penstock leading to the power house below. The gate house envelopes the forebay entirely and the flume is covered on top, its entire length, with planking.

The penstock leaves the wooden flume by a tapering piece and continues to the power house of uniform diameter—6½ ft.—where it branches into two pipes 4 ft. in diameter leading to the wheels. At the upper end the penstock is ¼ in. thick, which is increased to ½ in. at the lower end and it is about 360 ft. long.

The power house is a stone building 130 ft. long by 24 ft. wide on the inside, with the roof trusses 16 ft. clear of the floor. One end of the power house is set off for 30 ft. as the transformer room by a glass partition separating it from the generator room. At the time the power house was built, in 1899, but one wheel setting was installed, with a generator coupled to each end of the wheel shaft. This wheel, especially designed for this high head, was an inward discharge or Francis reaction turbine, rated at 1860 hp, at 327 r.p.m. The generators are Westinghouse, 600-kw, 500-volt, 60-cycle alternators, with 22 poles. The exciter set is entirely separate and consists of a 21-in. high-head turbine with a small generator direct connected to the wheel shaft, both standing upon the same cast iron bed. The exciter wheel is of 45 hp, with a speed of 600 r.p.m., and is fed by a 9-in. pipe from the large penstock. A gate valve controls the admission of water to the wheel.

FIG. 2.—DAM AND INTAKE END OF FLUME.

The transformer room contains 6 step-up oil transformers with cast-iron top and wooden cover. They are 500 kw, raising the 500 volts of the generators to 15,000 volts to transmit the current to St. John's, nine miles distant. The transmission line is a double-pole, and goes up over the hills back of the power house.

Early in 1902 the Reids decided to install the second wheel setting, as they had come into possession of the dry dock and large machine shops in St. John's, for which they would need extra power. Accordingly, Mr. Rice, their consulting engineer in this work, began the designs of a new wheel of the same capacity as the first one

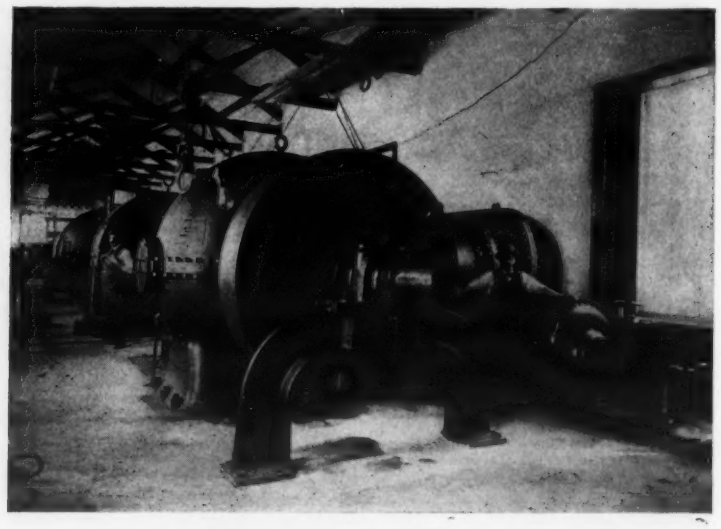


FIG. 3.—VIEW OF INTERIOR OF POWER HOUSE, PETTY HARBOR.

installed, but of a somewhat different pattern. Wheel No. 1, as mentioned above, was a Francis reaction turbine, and according to the general practice of turbine building, the discharge end of the buckets was somewhat throttled in order to obtain the full benefit of the reaction; good wheels of this type, being found to give 80 per cent. efficiency. But after a year or two of continuous running, pitting of the backs of the buckets takes place, until it is eaten clear through to the face.

At a recent meeting of the Pacific Coast Electrical Transmission

Association this subject was brought forward and it was shown that in addition to turbine buckets, the nozzles used with impulse wheels were often deeply pitted, while the backs of centrifugal pump runners, and often propeller blades, are eaten through to the front and the tips bitten off, causing much trouble to engineers. Electrolysis has been advanced as a cause, but careful tests showed that no electric current whatever passed through the parts. It is evident, however, that this pitting is due in some cases, probably to the sudden throttling of water under high velocity and the consequent scouring action of the eddies that are set up. Hence in the design of wheel

FIG. 4.—POLE LINE AND FLUME.

No. 2 this fact was taken advantage of and a turbine having a Girard type of bucket, but inward flow, was used. This form has a very free course and discharge for the water, giving a still better efficiency, and is expected to do away entirely with the pitting action.

In the controlling of this wheel for electrical purposes, Mr. Rice has introduced an entirely new feature, which should render this little plant of much interest to many engineers, from the fact that it was first tried and found successful in the remote and undeveloped Island of Newfoundland. The controlling gate of this wheel, to regulate its speed, is nothing else than a large hydraulic gate valve located between the penstock and wheel case, there being no inside

FIG. 5.—VIEW OF PETTY HARBOR, N. F.

gate of any kind near the guides as is usually the case. But the idea was to use the hydraulic cylinder, the piston of which actuates the gate, as the relay of a speed governor.

Accordingly, the speed governor of a Lombard water wheel governor was mounted on the hydraulic cylinder, the gate valve lying horizontally, the hydraulic cylinder of the gate corresponding to the large pressure cylinder on the standard Lombard governor, and the piston rod of the gate corresponding to the piston rod with the rack that operates the gate shaft on the standard Lombard governor

This arrangement gives perfect regulation, and works on the principle that the gate causes a reduction in pressure on the wheel side, corresponding to a reduced head, yet permitting the turbine buckets to receive the full application of water at all stages of the load. It also does away with all the inside wearing parts, such as the ordinary speed gates require. Both No. 1 and No. 2 wheels are equipped with momentum wheels 7 ft. in diameter, weighing 15,500 pounds, and running with a peripheral speed of 7,200 ft. per minute. All the wheel work was built and erected by the Stilwell-Bierce and Smith-Vaile Companies, while the electrical equipment, as already noted, was furnished by the Westinghouse Electric & Manufacturing Company.

American Street Railway Association Affairs.

In accordance with preliminary steps taken at the Detroit annual convention last October, the master mechanics, superintendents of motive power and electrical engineers of various street railways met at Cleveland on February 12 and organized the American Railway Mechanical & Electrical Association. Membership will rest in companies, and each member will be entitled to one vote by delegates presenting proper credentials. There will also be non-voting associate and junior membership. The meetings will be held at the same time and place as those of the National Street Railway Association. Dues are $20 for full membership, $5 for associate and $3 for junior. The association will restrict its work to the questions and topics that belong to the mechanical and electrical operating end of the business. The following officers were elected: President, Thomas Farmer, superintendent of motive power, Detroit United Railway Company, Detroit, Mich.; first vice-president, E. W. Olds, superintendent rolling stock, the Milwaukee Electric Railway & Light Company, Milwaukee; second vice-president, Alfred Green, master mechanic Rochester Railway Company, Rochester, N. Y.; third vice-president, C. F. Baker, superintendent motive power and machinery, Boston Elevated Railway Company, Boston, Mass. Executive Committee—W. O. Mundy, master mechanic, St. Louis Transit Company, St. Louis, Mo.; T. J. Mullen, master mechanic, Scranton Railway Company, Scranton, Pa.; H. H. Adams, master mechanic, United Railways & Electric Company, Baltimore, Md.; D. F. Carver, chief engineer, Cleveland Electric Railway Company, Cleveland, Ohio; secretary and treasurer, Walter Mower, Detroit United Railway Company, Detroit, Mich.

At a meeting of the Executive Committee of the American Street Railway Association, at Saratoga, on February 23, it was decided to hold the next annual convention there during September 2, 3 and 4, with headquarters at the Grand Union Hotel, which can accommodate 1,700 guests. The court of the hotel makes an admirable place for the display of exhibits.

Philadelphia Chapter of A. I. E. E.

A Philadelphia branch of the American Institute of Electrical Engineers is to be formed, and will hold its first meeting on Monday evening, March 9, at 8 o'clock, in the rooms of the Engineers' Club of Philadelphia, 1122 Girard Street (near 12th and Chestnut). This will be an organization meeting for the election of local officers and the adoption of a few by-laws concerning the time and place of meeting, etc. After organizing, the three papers on car lighting, which were presented at the New York meeting of Feb. 27, will be read in abstract, possibly by the authors themselves, and will be open for discussion.

President Scott, Vice-President Sheldon, Chairman Rice, of the committee on local organization, and Secretary Pope may be present. A temporary committee has arranged for this meeting and will suggest a list of officers and a few by-laws. The temporary officers are Carl Hering, chairman, and H. F. Sanville, secretary.

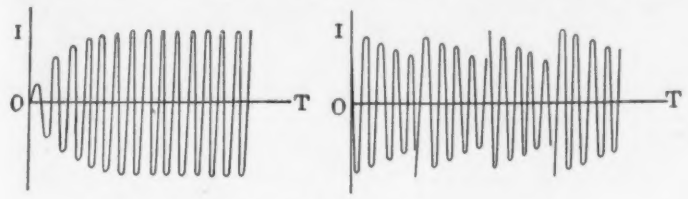
Government Wireless Telegraph Plant.

It is announced that the Government will erect the greatest wireless telegraph station in the world at Cape Henry. The Marconi system will not be used, but Commander Clinton Custis, of the Norfolk Navy Yard, says messages will be sent across the ocean. The principal use of the station will be to communicate with war vessels at sea, Tampa, Key West and Dry Tortugas and northern navy yards. The poles will be 200 ft. high.

Tuned Wireless Telegraph Circuits.

IN a paper in the December issue of the United States *Monthly Weather Review*, Mr. A. V. Thiessen describes in simple terms the principles of wireless telegraphy, and we abstract below the portion dealing with tuned circuits.

The simple wireless telegraph system may be called a "rapidly damped system"; that is to say, their oscillations die out very quickly. The mechanical analogue is a bell with a finger placed on its lip; when hit with a clapper the bell gives a large initial vibration, but the subsequent ones are feeble. It may be compared to a pendulum swung in a liquid. With this kind of a system it



FIGS. 1 AND 2.—OSCILLATIONS.

is not necessary to have accurate tuning, for by tuning is meant that the natural oscillations of the sending wire are the same as those of the receiving wire, so that the oscillations of the latter may be strengthened, before they die out, by rapidly succeeding impulses sent out by the former. By a tuned sending and receiving system is also meant a system the receiver of which will not respond to waves of some other frequency, and the sender of which will not cause a receiver of different tune to respond.

To have accurate tuning one must employ a sending system which is a persistent oscillator, and also a very rapid break and make device, so that the trains of waves succeed each other very rapidly. The receiving system must also be a persistent oscillator, so that before the oscillations set up in it by a preceding train of waves die out, they may be increased by the succeeding trains of waves. The conditions of oscillations to be satisfied in a tuned system are shown graphically in Figs. 1 and 2.

Fig. 1 represents the vibrations in the transmitting system and the waves sent out will have, of course, the same character. It is seen that before the oscillations completely die out another impulse is given, and that the several trains of waves succeed each other rapidly. Fig. 2 represents the vibrations induced in the receiving system; it shows the additive effect of all the separate waves which build up the oscillations in the receiving system until they finally break down the resistance in the coherer and a signal is heard.

If near the rectangle, *V U*, Fig. 3, a vertical wire be placed, as shown, the oscillations of that system would be induced in the vertical wire and then the desirable features of both methods would be combined. To further improve this a coil may be used having the terminals of its secondary, *S*, connected to the vertical and to ground, and inserting its primary, *P*, in the closed condenser circuit, as shown in Fig. 4. It is understood that the turns of *S* are wound around *P*, just as the secondary of an induction coil is wound around its primary, and that the coil described is a kind of transformer.

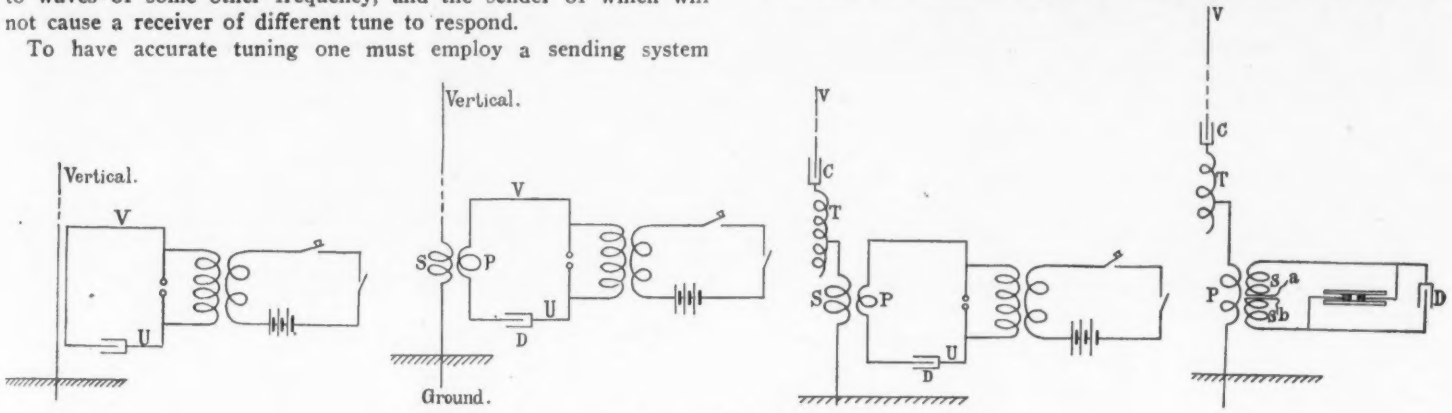
It is necessary to have the two circuits in tune; that is to say, the oscillations in the system vertical—*S*—ground must harmonize with oscillations in the closed condenser circuit, *P, D, U, V*. To tune these two systems a construction somewhat the same as that shown in Fig. 5 is used by Signor Marconi. To alter the tune of an electrical circuit either the capacity of self-induction or both must be changed. To this end a capacity *C* and a few turns of wire terminate the vertical wire. One terminal of the secondary of the Tesla coil may be moved up and down, cutting in or out as many turns as is necessary to sufficiently alter self-induction; the capacity *C* is also made variable. The tune of the closed circuit may be changed by altering the variable capacity, *D*, of its circuit.

In Fig. 6 the connections for the receiving apparatus are shown. The vertical, *V*, is terminated with a few turns of wire, so that its induction may be changed. It is connected to one terminal of a transformer, *T*, the other terminal of the primary, *P*, being grounded. The terminals of the secondary, *S S*, are connected to terminals of the coherer, which has a variable capacity, *D*, which is connected in parallel to the coherer. Any induction or capacity may be added to the terminals, *a* and *b*, of the secondary coil. It is seen that a receiving system similar in construction to the sending system in Fig. 4 is given. It is a good absorber, a persistent oscillator, and capable of having its tune altered at will.

A duplex system may be arranged with the system just described by connecting differently tuned transmitters to verticals through different inductances at the sending station; and by connecting a suitably tuned receiver the same way to the receiving vertical. The connections for the transmiter are shown in Fig. 7.

In general we may speak of two kinds of telegraphic systems, namely, tuned and untuned. It is evident that with a perfectly tuned system of transmiters and receivers the number of stations may be multiplied and placed at will, connecting points far and near.

A system that is not arranged for tuning is called an open system,



FIGS. 3, 4, 5 AND 6.—TUNED WIRELESS TELEGRAPH CIRCUITS.

and with such an open system the selection of stations cannot be done arbitrarily. To illustrate: Suppose we wish to connect two points, *A* and *B*, Fig. 8. Set up instruments of the open system at each point; assume that the waves sent out having traveled a distance, *A B* are just strong enough to work the receiving instruments. Now circumscribe both stations with circles having a radius equal to the distance *A B*. It may be seen that no other two in-

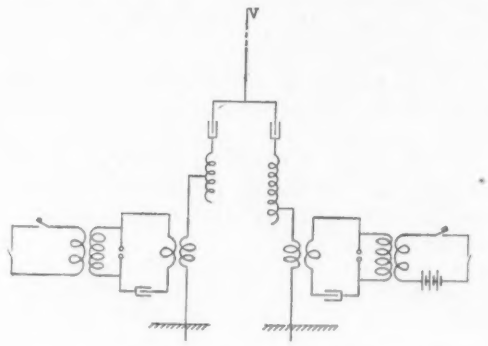


FIG. 7.—CONNECTIONS FOR TRANSMITTER.

dependent stations can be worked within these two circles without confusion unless they have receivers which cannot be affected by the feeble waves from *A* and *B*. For example, two independent stations may be erected at *C* and *D*, with less sensitive receivers and weaker transmitters than those at *A* and *B*. The waves sent out by the transmitters at *A* and *B* cannot affect the less sensitive receiver at *C* and *D*, and the waves sent out by less powerful trans-

mitters at *C* and *D* will affect receivers at these points, but on arrival at *A* and *B* they will be so weak that the receivers at these points will not be affected. Thus, stations properly placed, with

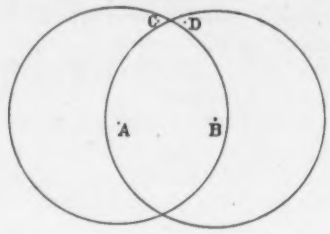


FIG. 8.—OPEN SYSTEM.

instruments properly selected as to power and sensitiveness may be worked "open" simultaneously and without confusion.

Elster and Geitel's Improved Form of Exner's Electroscope.

BY A. FREDERICK COLLINS.

THE apparatus shown in the accompanying diagrams was designed by the eminent physicists, Messrs. J. Elster and H. Geitel, whose work is well known in connection with radio-activity measurements and deductions.

Exner's electroscope, in view of its various advantages, among which may be cited its small capacity, convenient and handy form and ease of conveyance, especially in relation to atmospheric electricity, has maintained its superiority. By means of an improvement in the construction by Elster and Geitel, namely, through the transferring of the insulated fastenings of the plate carrier in the interior of the electroscopic casing, the can be as nearly perfected as it is possible to make it with the normal self-ionization of the air.

Heretofore the reading of Exner's electroscope has not only been difficult but even defective for the reason that the scale was pasted on the front glass wall of the casing; in this case the scale lies nearer the eye than the plates and the greater the difference in the distance the more pronounced will be the parallax between the plates and the scale. Again observers with eyes of different focal lengths will bring the instrument in various positions relative to the eye—either closer or farther distant, and thus effecting important variations of the reading.

To overcome these errors Elster and Geitel have devised a simple contrivance which disposes entirely of this difficulty and moreover renders it possible, by means of a magnifying glass, to more accurately make the readings. The principle involved is to remove the scale from the glass wall of the casing entirely and instead, project its picture by reflection on the plates or discs themselves.

In the accompanying diagram shown in Fig. 1, the electroscope presents a side view. *A B* is the carrier of the two aluminum discs, the one, *C D*, which is projected on this carrier, being presented to view. The front glass wall of the casing is silvered on the interior surface at the lower part to *G*—the sharp upper border of the silvered surface at *G* running in a horizontal line.

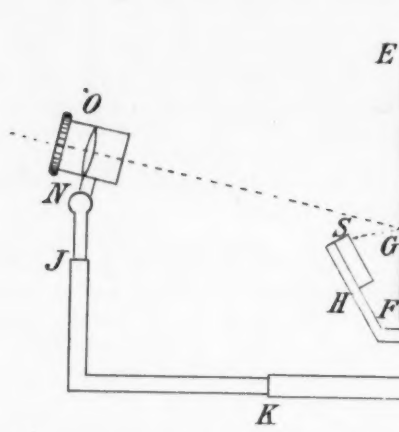
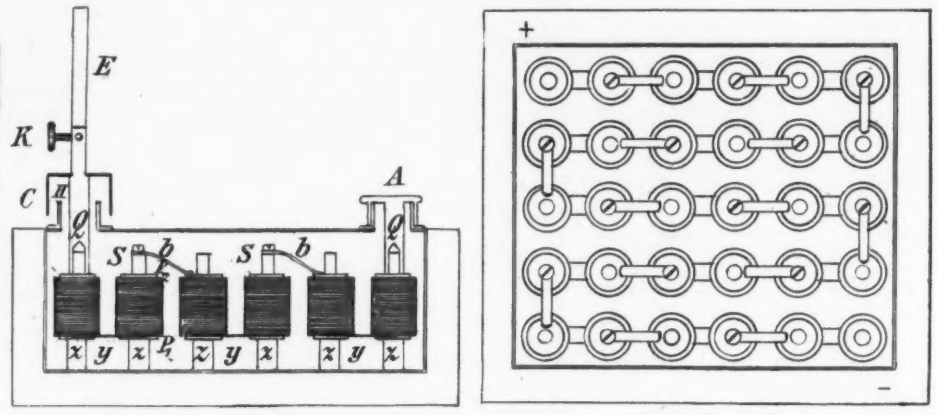


FIG. 1.—SIDE VIEW OF ELECTROSCOPE.



FIGS. 2 AND 3.—PORTABLE APPARATUS FOR DETERMINING RADIO-ACTIVITY OF AIR.

The upper border of the scale, *S*, which is fastened to the holder, *H*, is the same distance in front of the silvered surface, whilst the front edge of the electroscopic plates or discs is oppositely disposed in the rear. This enables the eye at *O* to perceive the picture or reflection of the upper border of the scale on the same level as the edges of the disc facing the eye.

A parallatic shifting of the plates or discs against the reflection of the scale by a change of the position of the eye is therefore not possible. In fact, it is possible with the assistance of a magnifying glass fastened at *O*, through which the divergence of the discs is enlarged in the same manner as the picture on the scale and assists in the accuracy of the reading. At *J* and *K* the magnifying glass may be placed horizontally and vertically and at *N* it may be adjusted on a level with the drawing. The magnifying glass is in the correct position when, to the observing eye, the upper edge of the reflection of the scale merges with that of the silvered surface; the rear wall of the casing is formed by a semi-opaque glass prism, and by means of a micrometer screws at the base of the instrument a symmetrical adjustment of the plates may be obtained.

The position of the front edges of the plates is always read off or reproduced on the scale; this standardizing permits of symmetrical or equal results on both sides. A slight deviation of uniformity in the position of the plates is on the whole unimportant, as the one having a surplus of the required amount and the other an insufficient amount when the results of both sides may be deducted and added accordingly.

A portable apparatus for determining the radio-activity of air is shown in the following diagrams. In this case it is necessary that the body to be tested be placed for a few hours on a negative potential of several thousand volts. In all cases in which a static electric machine or an induction coil is made difficult or excluded entirely, Elster and Geitel have, with excellent results, made use of a high-tension dry pile or column consisting of 6,000 pairs of elements (platten-paaren) of the usual type made of gold and silver foil; this battery is divided into thirty separate columns, each of which have a potential of approximately 75 volts, the piles being arranged on an ebonite rod and placed in insulated metal casings. When the column is not in use the self-discharge may be greatly decreased by disconnecting the parts. An external covering of the column preserves the elements and the ebonite insulators from dust, moisture and light.

Fig. 2 presents a vertical view; the supports of ebonite merge into sustaining rods of the same material on which are arranged the single, centrally-perforated elements. The number of these elements is so chosen that they are firmly held in place by the pressure of the metal plates, P^1 and P^2. The continual insertion of the separate parts is instituted by the elastic metal strips attached to *S*, so that the column when ready for use and viewed from the top assumes the dimensional form portrayed in Fig. 3.

Through the metal cover of the casings enclosing the columns, which are made almost air-tight by means of soft rubber bands, are inserted short metal extensions or projections, *H*, which are arranged at suitable intervals through which, after the removal of the cover, metal tubes may be attached and passed through to the interior of the casing at *E;* these tubes slide over the projections, *Q*. At *K* they carry a set-screw for fastening the leading-in wires. The tightly adjusted metal cylinder, *C*, should exclude as much as possible the

penetration of moist air. At one of these tubes, *A*, the insulating handle is eliminated; the pole of the column will thus be connected with the metal casing, and this extended to the ground; in Fig. 1 the pole at the right of the column is thus manipulated.

While operating the column it is necessary to control the tension with a high-tension electroscope. For this purpose Elster and Geitel chose the form invented by Dr. Braun, the well-known savant of Strassburg, who designed the Braun-Siemens & Halske system of wireless telegraphy. Braun's electroscope is shown in Fig. 4, a slight modification being made, however, by the introduction of Bernstein's insulator and an arrangement, *N*, for drying the interior of the electroscope with natrium. The metal column, *M*, carrying the index or indicator, *Z*, is put into a Bernstein holder at the bottom of the metal casing. The metal pin, *S*, furnished with a set-screw and isolated handle, *E*, and is fitted into a conical groove through the medium of a sliding connection. Should the electroscope after being separated from the column not work properly, the metal pin, *S*, is to be removed, the metal cover, *D*, closed and the handle, *H*, turned to 90°; the stirrup, *B*, presses the upper part of the index, *Z*, against the column, *M*, very lightly. The instrument is then to be taken from its supports and enclosed in the casing. A current cannot be taken from the column, but its purpose is—and on this point particular stress is laid—to keep the conductor at a constant potential of 2,000 volts.

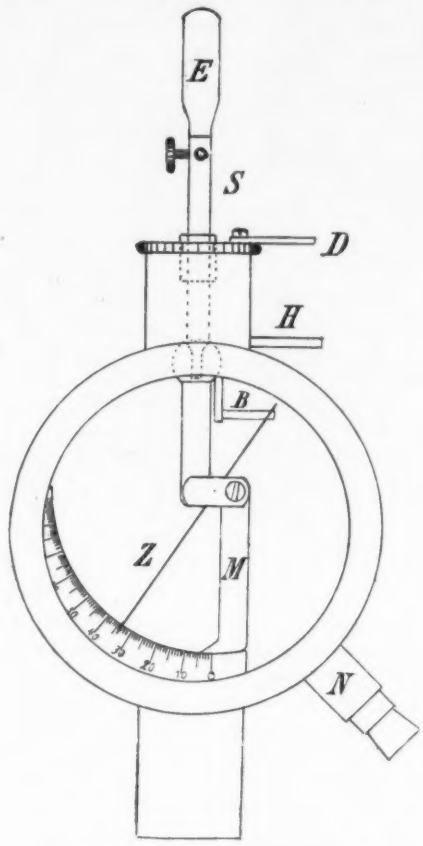


FIG. 4.—BRAUN'S ELECTROSCOPE.

Notwithstanding all precautions, it is possible that the column, in consequence of the difficulty experienced in absolute insulation of the exposed conductor, or owing to penetration of moisture to the interior of the casing will deteriorate and constantly decrease in tension. Should this occur the cover is to be opened and to be placed in the warmth of a stove for several hours, when the cover is again closed, thus giving the column an opportunity to become thoroughly heated. Should the instrument not be used for a long time, the connections between the columns after being securely protected are to be kept in a warm dry place. During transportation silk cushions are employed to fill the space between the column and cover; this precludes all danger from breakage.

According to Elster and Geitel, these battery columns will remain in excellent condition for several years. When the elements are exhausted—which of course cannot be avoided—they may be replaced with ease.

These columns and electroscopes have maintained their superiority for years in virtue of their adaptation to open air researches, in the moist air of cellars and wells, and on expeditions, as, for example, when experiments was made relating to the radio-activity in caves and at the shore of the North Sea.

A Simple Current Interrupter.

BY C. FRANCIS JENKINS.

THE use of the Ruhmkorff or induction coil is rapidly coming into use for a variety of purposes, not only in the laboratory but in commercial work as well. It is also a fact that no entirely satisfactory interrupter has yet been brought out. When the coil is used on the main wiring circuit of the building, as is almost always conveniently available, lamps or some other suitable unvarying resistance must be put in circuit with the primary. Even when this is done the platinum contacts on the coil get hot and burn if heavy sparks are required. To overcome these defects various devices have been employed, the Wehnelt interrupter being one of the simplest of them. In the Wehnelt interrupter, however, trouble

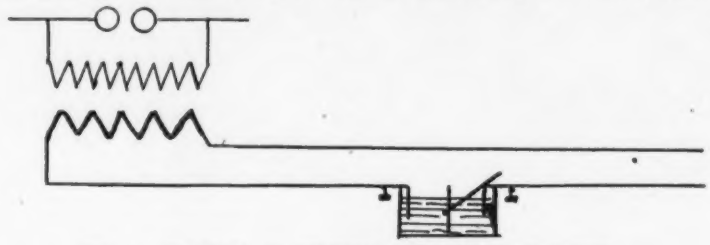


FIG. 1.—DIAGRAM OF CIRCUITS, CURRENT INTERRUPTER.

is experienced with the mercury-filled glass tube and its platinum point. This gets hot and the glass tube frequently cracks, destroying its usefulness.

The function of the platinum point seems to be to focus the current upon the solution to form bubbles of steam (or gas) which interrupt the current, momentarily re-establishing it again when the bubble rises and the solution again completes the circuit. If the function of the platinum point is thus to focus the current in the solution, any other method which would do this would answer, doubtless. The device herewith illustrated depends upon this theory and has proved satisfactory. It consists of a glass cell (or any other cell

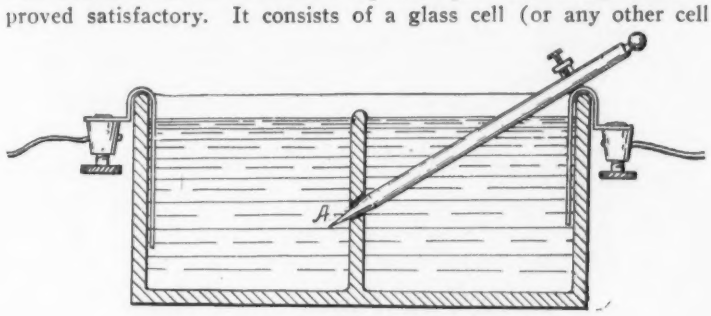


FIG. 2.—CURRENT INTERRUPTER.

of suitable insulating material) with a partition dividing it into two compartments, the partition having a small aperture therein fitted with a pointed glass rod. Circuit terminals are inserted in each compartment. Into the cell is then poured an acidulated solution of a strength depending upon the potential of the line in which the interrupter is used. The cell is then put directly in series with the primary of the coil, and the vibrator (if the coil has one) is screwed up until it is constantly in contact. When the main circuit is closed a violent ebullition takes place and a veritable torrent of flame surrounds the aperture in the partition, accompanied by a strident noise and a rapid interruption of the current. The greatest amount of current flows when the aperture is wide open. The interruptions increase in frequency and the current diminishes as the point of the rod is further and further advanced into the aperture. The device is therefore not only an interrupter but a variable resistance as well.

This cell has many advantages. It is inexpensive, reliable, contains nothing to get out of order, can be put directly in the circuit in series with the primary of the coil, and is adjustable to give a different flow of current and a wide range of interruption. Possibly the method might be of use in experiments requiring the boiling of water in a vessel insulated from the heat of the atmosphere, etc.

The Use of High Tension Underground Conductors.

By Henry Floy.

BASING the conclusion on figures recently secured direct from various manufacturers the writer estimates that there was expended in the United States during the year 1902 at least $14,000,000 for the purchase of insulated conductors designed for the transmission of electrical energy other than that used in telegraph and telephone service. Of this considerable outlay a comparatively small part, probably not over one per cent., was invested in what may fairly be termed high-tension insulated conductors; that is, conductors which are used for transmitting energy at a pressure of at least 10,000 volts.

It is a remarkable fact that while the engineering profession has made rapid strides in the utilization of higher and higher voltages for electrical transmission until at present 40,000 volts is not considered extraordinary, and 60,000 volts is employed in at least one installation, all of this advance work is being done with the use of aerial circuits, and very little has been accomplished through the use of an insulated conductor in the form of a cable. It is almost possible to count on the fingers of one hand all the installations in the world which are transmitting energy at 10,000 volts or above by means of underground cables. This is the more surprising when it is considered that several comparatively high-tension underground systems have been in operation a number of years, that they have given almost perfect satisfaction and that not one of them has proven a failure.

For several years, as is well known, Ferranti has been operating successfully a single-phase, high-tension underground transmission in London. During the past six years, the Twin City Rapid Transit Company, of Minneapolis, has had in constant operation two 11,000-volt, three-conductor cables respectively ten and ten and three-quarter miles in length. Two and one-half years ago the St. Croix Power Company installed in St. Paul two three-conductor cables, each a little over three miles in length, which have ever since been in satisfactory operation at about 25,000 volts.

Buffalo is distributing thousands of kilowatts of power from Niagara Falls through 10,000-volt cables. The Montreal Light, Heat & Power Company last autumn put into successful operation a considerable length of 22,000-volt, and a few hundred feet of 30,000-volt cable. In New York City the Manhattan Elevated has laid about twelve miles of "unusually high" 11,000-volt cable, part of which has been in satisfactory operation for over a year. The Rapid Transit Underground Railway has installed thus far some 20 miles of 3-0 tri-phase, 11,000-volt cable, and it is even whispered that the city is to see a 44,000-volt underground transmission in the not distant future.

It will be argued by some engineers that one reason for the slow introduction and small use of high-tension cable is due to the relatively small saving in copper and greater cost in insulation resulting from increasing the pressure. It seems to the writer, however, that this conclusion is not warranted, judging from the figures he has available as to the relative cost of the cables suited for different potentials up to 25,000 volts. Furthermore, such conclusion entirely neglects a consideration of the money that may necessarily be invested for transformers, real estate, etc., as for example in the Niagara Falls-Buffalo transmission, where, although 20,000 volts is being used on the overhead line, step-down transformers are interposed to reduce the voltage from 20,000 to 10,000 volts before the energy is distributed underground.

While it may be necessary to confess that we have not yet found the ideal insulator, which must be water and heat-proof, flexible, a perfect dielectric with low capacity, and withal inexpensive, nevertheless with the insulation now available we are prepared to make much further advance and widespread use of underground conductors than has heretofore been done. Perhaps the present and increasing price of Para rubber does not encourage the partisan of rubber insulation to the belief in the growing use of high-tension insulated conductors, but resin, oil and paper cost considerably less and conductors insulated with the latter materials have fully demonstrated their trustworthiness and long life in actual service.

The insulation of a cable should satisfy, it seems to me, the following conditions given in the order of their importance: First, strength against rupture; second, durability, and third, minimum leakage.

Tests of small areas of insulating material prove but little. Ignorance of the properties of insulating material may lead one to seek a very high test in megohms as the qualification necessary for a high-tension cable. Megohms may be serviceable in "facilitating fault finding," but as a measure of volt resistance they are of little value. Don't pay for megohms per mile when what you want is disruptive strength.

Strength against rupture depends upon the character of the material and the skill exercised in applying it to the conductor, and while a material used may show comparatively small insulation resistance, it may at the same time show very high rupture strength; on the other hand, a small quantity of insulation may be good and a larger quantity but very little better.

It is becoming pretty generally realized that high insulation depends not so much upon the material used as upon treatment of that material. The processes of manufacture are very much more important in high-tension insulation than designation of material or specification of thickness. In fact, the conditions surrounding the process of manufacture are so important that a representative of one prominent manufacturing concern stated to me that he considered it probable that with the same material and workmanship we could produce in this country cables better adapted to high-tension work than could be manufactured in England, for example, owing to our better climatic conditions.

To properly test the insulation of a cable involves applying the tests to considerable lengths of the completed cable. It is questionable whether after a cable is laid, it is advisable to test it very much above the working pressure, as such a test may permanently injure the insulation. It has been suggested that it is better to measure the insulation against rupture over a sample of the total cable requiring a considerably larger factor of safety than customary, and if the sample passes this test assume that the cable as a whole will do so.

High-tension cables are not such "breeders" of harmonics, resonance oscillations and such phenomena as may commonly be supposed. Possibly the elaborate theoretical calculations of certain writers on "Oscillations" may unnecessarily have prejudiced those not experienced with high-tension transmissions, and deterred the use of cables in connection with such installations. As a matter of experience it may be interesting to note the fact that the St. Croix cables, although of considerable capacity and on one end of a 25-mile overhead transmission, have never failed from "oscillations" even though the switches have been opened under short circuits. Mr. Fred. R. Cutcheon, the electrician of this company, writing me recently as to his experience along these particular lines, said:

"We usually notice a discharge on the arresters, especially at the generating end, when switching cables in and out of parallel. We find less disturbance when we cut in and out cables at the distributing end first and then at the generating end. The rise in voltage, however, is only about 5 per cent. There have been three occasions to my knowledge when the high-tension switches have been used to open the circuit under short circuit. On two of these occasions the current jumped across insulators on the switches, but I am not certain whether this was caused by the switching or was due to a previous breakdown at another point. On the third occasion I opened the switches when we had a short circuit on the low-tension side of the step-down transformers and no bad effect was noticed. On the whole, I am inclined to believe that switching does cause serious rise in voltage, for a sudden change of load seems to produce a strong surging discharge on the arresters when the generators remain in circuit with a portion of the previous load, although this may simply be due to the oscillating character of our water-wheel governors."

The high static capacity of cables as compared with aerial lines is looked upon by some engineers as an objection. Certainly not as an advantage, but may it not be a gain to have added to the system an element which will result in increasing its power factor, thereby reducing the size of the generating and distributing apparatus required for a given output. The question of the increased capacity affecting the line regulation is unimportant, for the old plan of holding the voltage constant at the generating plant is being abandoned for that of constant pressure at the point of distribution. Possibly those who prefer rubber to paper insulation, appreciating the value of the gain in capacity, might be willing to pay the additional cost for rubber in their cables, as a rubber cable will have about double the capacity of a cable designed for the same conditions as to voltage and conductivity.

The question has been raised whether there are variations in the

capacity of a cable with variation in voltage, but published tests made by Felton & Guillaume on a lead-covered cable indicate that the capacity of a cable shows no change whatever with potentials ranging between 1,000 and 10,000 volts.

Some early measurements made by the writer on the St. Croix cables seemed to show evidence of undue and unexplainable drop in voltage throughout their lengths. In a later attempt to make exact tests to definitely settle this matter, some of the apparatus was burned out, and the writer coming in contact with a 25,000-volt circuit, he left open a question which he has no further opportunity to investigate.

The St. Croix Power Company has never had any trouble with its cables that was directly traceable to lightning, although the cables are connected direct to the end of a 25-mile aerial line I am inclined to the opinion that lightning will seldom injure cables, as they act as a condenser, on somewhat the same plan conceived by Mr. Thomas, of the Westinghouse Company, in connection with his system of lightning protection. In this conclusion, Mr. O. Schaffer, manager of the Duisburg Cable Works, agrees with me that there is practically no danger to cables from lightning when forming part of an overhead transmission circuit, although no arresters whatever be installed at the point of connection.

Because of the many advantages in the way of durability of construction, freedom from wind, weather and lightning, avoidance of malicious interference, elimination of danger of crosses and grounds from other circuits, non-interference with fire departments, and the strong prejudice to poles and overhead transmission lines anywhere except in open country, does it not seem that the more extended use of high-tension underground cables is delayed not by the cost or inability to manufacture successful insulated cables, nor by the opportunity for the use of such cables, but largely by an overconservatism in this particular direction?

Alternating Currents in Coal Mining.

In a paper recently read before the American Institute of Mining Engineers by Mr. W. B. Clarke, reference is made to the extensive electric coal mine haulage plant at the mines of the Berwind-White Coal Mining Company in the Allegheny Mountains, near Altoona, Pa. The plant has a capacity of 2,900 kw generated in 8 power houses, and supplies 44 mine locomotives having an aggregate horsepower of 4,400, the number of miles of underground trolley being 75. The paper describes in detail the mine haulage plant installed at Ehrenfeld, Pa., by the Webster Coal & Coke Company, which is the first to embody the advantages of underground transmission with alternating currents at a high voltage. The haulage at this mine was accomplished by the rope system and mules until the main heading attained a length of nearly two miles, when the necessity of substituting a more efficient and flexible system became very apparent. Since the main heading will eventually extend five miles underground, there was practically no alternative, and an electric haulage system was adopted which embodies the generation of three-phase, 25-cycle, 5,600-volt alternating currents near the pit mouth. This is transmitted to a sub-station in the mine near the center of actual operations, and 9,000 ft. from the power house, where, by means of transformers and a 250-kw converter, a direct current at 275 volts is delivered to the haulage circuits.

The power house contains two 150-kw General Electric, belt-driven, double-current generators, separately excited and delivering direct current at 275 volts from one side, and from the other three-phase alternating currents at 165 volts. The direct current at 275 volts is fed into the outer end of the haulage circuit in the usual manner, one terminal of the generator being connected to the trolley circuit and the other to the rail return. The potential of the alternating currents is raised from 165 to 5,600 volts by "step-up" transformers. The transmission line consists of a three-conductor, No. 6 B. & S. rubber-insulated, lead-covered cable, laid in the return air-way, which parallels the main heading.

The step-up transformers in the power-house and the step-down transformers in the sub-station are oil-cooled and are duplicates. Taps are brought out from the primary windings in order to compensate for the line-loss and consequently the direct-current voltages of the rotary converter and the generators at the power house are the same. The transformers are connected in "delta," so that the temporary disconnection of one of them cannot affect the system, beyond overloading the remaining two.

The double-current generators in the power house are simply rotary converters, being duplicates of the converter in the sub-station, with their shafts extended to receive the driving pulleys. It is proposed, as the occasion requires, to remove these two generators from the power house and establish additional rotary converter sub-stations in the mine beyond the present sub-station. A 300-kw engine-driven, revolving-field alternator has recently been installed in the power house, and delivers 5,600-volt, three-phase currents direct to the transmission line without the interposition of step-up transformers. A duplicate unit will be added at a later date, and direct current for the outer end of the haulage circuit will probably be supplied by a rotary converter, located in the transformer room of the power house, although it may prove advisable to retain one of the double-current generators permanently for this purpose. By using the double-current generators a very considerable saving in the original investment was effected. These machines have operated in the most satisfactory manner, and their regulation with rapidly varying alternating and direct-current loads has been surprisingly good.

In many mines the conditions are such that double-current generators would constitute an ideal permanent installation. The alternating-current induction motor, with its "squirrel-cage" armature, is pre-eminently suitable for use in coal mines, on account of the absence of the commutator and of armature insulation. The Davis Coal & Coke Company, for instance, with extensive operations in West Virginia, use direct current for mine haulage only. For all other purposes, alternating-current induction motors are employed, and generators of both types are installed in each of the power houses. By means of the double-current generator, both classes of service may be operated from one machine, while at the same time the advantages of high-voltage transmission may be secured by the use of step-up transformers. The author predicts an extensive field for the double-current generator in mining work.

In the installation described above, a cable containing three No. 6 B. & S. wires transmits 350 hp with a line loss of barely 5 per cent., and delivers direct current to the trolley circuit at 275 volts. On the other hand, if the direct-current system were used with a voltage as high as 300 at the power house and 250 at the center of distribution, i. e., 16.6 per cent. line loss, the transmission line would consist of eighteen No. 0000 feeders on one side of the circuit and six No. 0000 feeders in addition to the bonded double track on the other side. With the alternating-current system the copper for 5 per cent. loss weighs 2,200 lbs., while with direct-current system the copper for 16.6 per cent. loss would weigh 138,500 lbs., and for 5 per cent. loss approximately 560,000 lbs.

The system of power distribution outlined above is especially suitable for the operation of several neighboring coal mines from one central power plant. The United States Coal & Coke Company are at present installing an interesting plant of this nature in the Tug River field, near Welch, W. Va. The initial installation consists of 400-kw, 6,600-volt, 25-cycle, three-phase alternators, operating three 150-kw, 275-volt rotary converters, together with induction motors for driving coal crushers and conveyors. At first three mines will be operated from this central power plant, but other openings will be added from time to time.

Train Signalling in France.

A dispatch from Paris says: "The Basantias system of electric intercommunication between moving railway trains was successfully demonstrated and explained on the Chemin de Fer de l'Etat line this afternoon on sections of the track between the Chateau du Loire and the Chateau de la Vallière. Two sections of the train traveled a considerable distance apart and were then brought into the same block. There was a telephone and alarm bell in a car of each section, so that when the two sections—which in actual use means two separate trains—were found in the same block both alarm bells rang and signalled the danger. A shoe at the side of the car slides on a wire string alongside one of the rails, and signalling on the alarm bell occurs the moment both trains are in the same block and therefore in dangerous proximity. Constant communication was also maintained yesterday between passengers of the two sections of the train by means of the telephone. A speed of eight to ten kilometers per hour is required to give to the dynamo attached to the axle the speed necessary to produce a sufficient current for this purpose."

Electrical Exhibits at St. Louis, 1904.

ONE of the most important departments of the World's Fair that will be held in St. Louis during 1904, and a department that will attract much attention, is that of electricity. The building in which the electrical exhibits will be seen, the Electricity Building, is, according to the latest statement of the Director of Works, 95 per cent. completed. It is beautiful and imposing and is already attracting the attention of the thousands of visitors who flock to the grounds on Sundays. The very liberal use of Greek honeysuckle ornamentation is noticeable, especially around the interior court, where hundreds of these graceful designs, following the roof lines of the building, can be seen silhouetted against the sky.

The building is in direct contrast to the Education Building, just across the Grand Basin, for, although the two are identical in size and ground plan, yet the latter is severe and dignified, its imposing rows of Corinthian columns and unbroken sky line being directly opposed to the general contour of the Electricity Building, with its massive corner towers and step-like roof construction, the lines of which are well defined in the scheme of ornamentation. While the interior court of the Electricity Building is not so large as that of the Educational Building, still the colonnade and elevated promenade are more pleasing to the eye, and with the completion of the decorative scheme involving statuary, palms, flowers and perhaps electro-aquatic features, it will be one of the most attractive spots on the grounds.

The lighting of the interior of the Electricity Building has received especial attention, and the general arrangement of the main aisles, as shown in the accompanying ground plan, is one in the development of which the interests of the exhibitors were carefully considered.

The exact location of the various classes of exhibits has not yet been definitely determined, but it is probable that the foreign exhibits will occupy the north and east corridors of the building, while the entire western portion will be devoted to the display of the heavier classes of electrical apparatus.

Attention has been called more than once to the fact that Chief Goldsborough has, in all his departmental circulars, especially emphasized the value of working exhibits, and that this idea has met with the favor of manufacturers throughout the country is evidenced by the fact that the greater number of applications now on file specify a working exhibit will be made; many of these are on a much larger scale than anything that has heretofore been attempted in exposition work.

Perhaps the most spectacular of the working exhibits will be made by the companies now actively engaged in the commercial application of wireless telegraphy. The most important of these are arranging to install exhibits on a large and comprehensive scale, which will probably be in touch with stations erected in Chicago, Minneapolis and other Western cities.

The opportunities for a demonstration of selective signalling through space thus afforded are good and the ability of any system to send and receive messages simultaneously with the working of other sending and receiving wireless telegraph stations will form a conclusive proof of the commercial value of this late and most interesting development in the electrical field. The various methods of duplex and multiplex telegraphy, as well as wireless telephony, will also be shown, and it is the desire of Chief Goldsborough to bring together working examples of every system for the electrical transmission of intelligence.

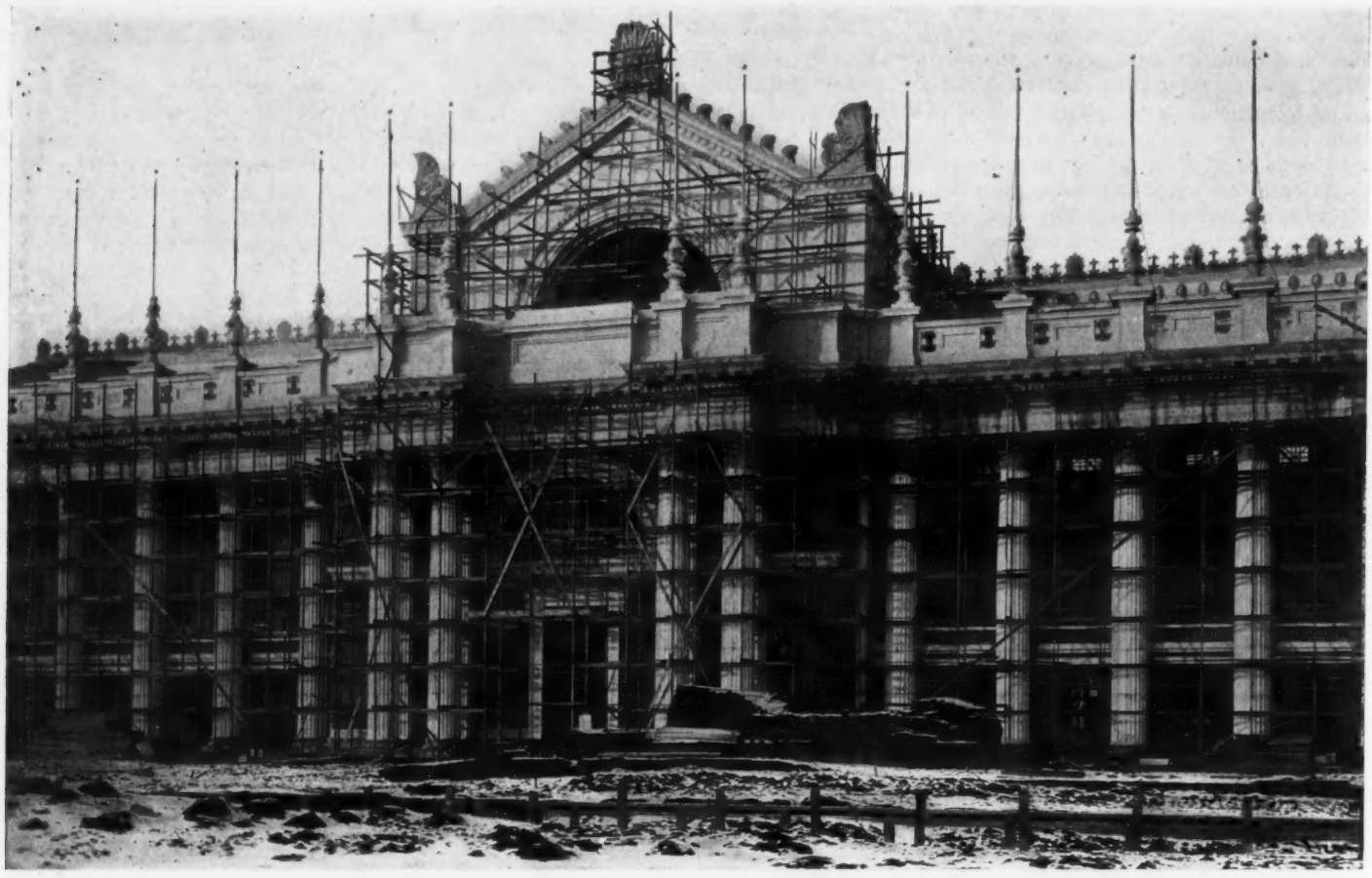


FIG. 1.—SOUTH ENTRANCE ELECTRICITY BUILDING, ST. LOUIS EXPOSITION.

Several applications are now on file involving most elaborate and lucid expositions of the principles involved in the various methods, and in addition to providing an object of curiosity to the millions of laymen, the exhibitor will be afforded ample opportunity to lay before the electrical fraternity and those interested in the technical and commercial development, the possibilities of the apparatus.

Another important branch will be that devoted to the electrochemical interests, and various electrochemical processes will be shown in operation. The Department of Mines and Metallurgy is co-operating in the arrangement for these displays.

The many electrochemical industries that have sprung up in Buffalo, Sault Ste. Marie and various other points in this country, as well as in Europe, are taking a lively interest in the possibilities for the exploitation of their products, and the reduction of ores, the manufacture of calcium carbide, various alkalies, and even of carborundum, it is hoped, will be carried on.

Storage battery makers will show the process of construction and demonstrate the advantages of their product, and, in all proba-

bility, very extensive tests will be made to determine the performance of the many accumulators now on the market. Several of the largest storage battery manufacturers in the United States have already filed applications for space, and it is understood that several of the leading German manufacturers will exhibit accumulators on an extensive scale.

Of live interest to all will be the exhibit of light-emitting devices. The developments of the past few months indicate that, by the time the Exposition is opened, several new types of lamps will be manufactured on a commercial scale. The exhibit of electric lamps will include, in addition to these, historic displays illustrative of the development of this important phase of electrical progress.

The advantages to be derived from a comprehensive display of electrotherapeutics and electrosurgical apparatus have appealed to the profession at large, as well as to the manufacturers of this ap

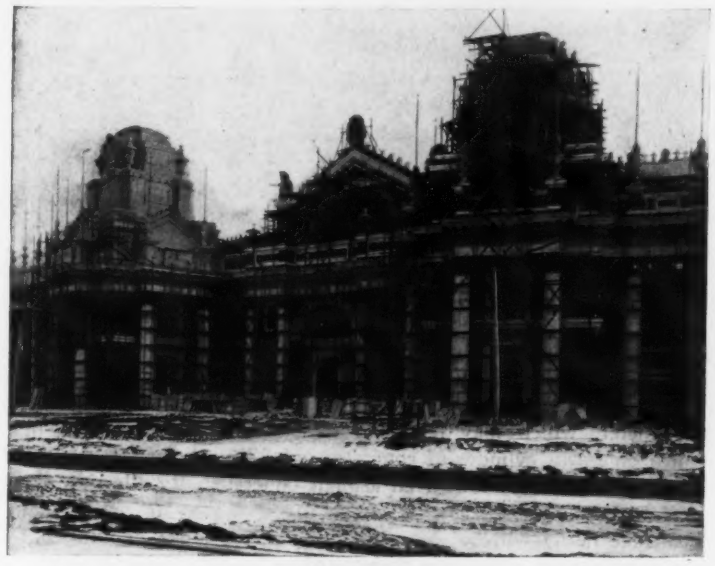


FIG. 2.—NORTH ENTRANCE.

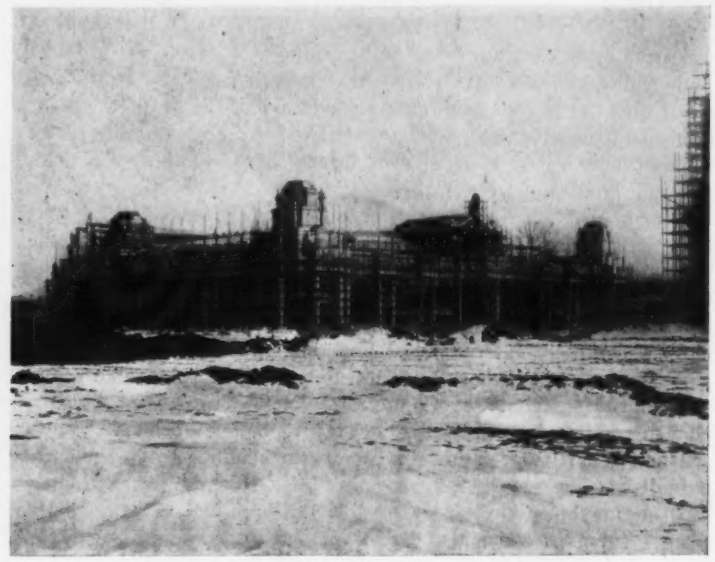


FIG. 4.—NORTH AND WEST SIDES.

FIG. 3.—ANOTHER VIEW OF ELECTRICITY BUILDING.

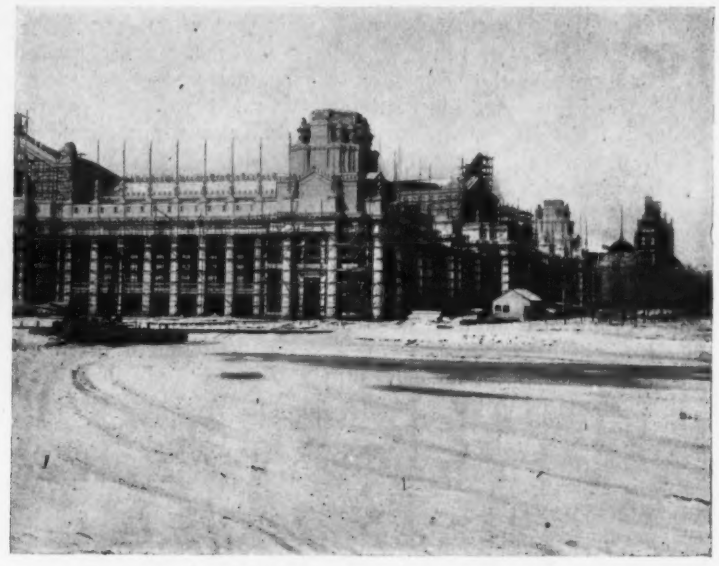


FIG. 5.—ELECTRICITY BUILDING FROM GRAND BASIN.

VIEWS OF ELECTRICITY BUILDING, ST. LOUIS EXPOSITION.

paratus, and the action recently taken by the American Electro-Therapeutic Association is indicative of the universal desire by its members that the profession be adequately represented.

The opportunity to exhibit in the Electricity Building is being rapidly taken advantage of, and it is learned on good authority that over 80 per cent. of the space appropriated to American exhibits has been applied for.

The organizing committee for the World's Fair Congress of Science and Arts adjourned on February 24, after a session of two days in New York, attended by Dr. N. M. Butler, of Columbia University, and World's Fair Director John Schroers, of St. Louis. Prof. Simon Newcomb, of Washington City, was designated as President of the Congress, with Hugo Muensterberg, of Harvard, and Albion W. Small, of Chicago University, as Vice-Presidents.

Electric Ore Smelting.

An experimental plant has been established at Lockport, N. Y., to apply the Ruthenburg system of ore smelting by electricity. From an electrical standpoint the interesting features consists in the holding of the magnetic ore (during the melting) as a bridge between opposing rolls, which are water-cooled and do not get hot. Though the rolls are faced with carbon, the carbon is not for the purpose of acting as a hot electrode, but in order that should the furnace flash it will not weld the metal to the rolls.

Dry, cold magnetite is a non-conductor. Formerly a furnace was started by wetting the magnetic bridge with salt water. When hot the bridge is a fairly good conductor. More lately this trouble has been overcome by mixing a small proportion of fine cast iron borings or shotted pig iron with the ore. This reduces the voltage required to force 1,500 amp through a bridge 1¼ in. x 1¼ in. x 10 in., from 150 volts to 70 volts.

It is claimed that the finest and dustiest magnetic concentrates which cannot be used in a blast furnace make an ideal charge for this electric smelting. Besides, the more finely the ore is ground the more thoroughly it may be freed from silica and phosphorus. An example of this is Port Henry magnetite, crushed to roughly an eight mesh carrying .6 per cent. of phosphorus. This is crushed to 60-mesh and the concentrates carry but .135 per cent. phosphorus. The power consumption is stated to be 450 kw-hours per ton of product, or the continuous expenditure of 19 kw will produce a ton in 24 hours. Fifteen per cent. of carbonaceous dust is mixed with the ore charge and the product of the rolls has 10 per cent. less oxygen than the raw ore. Dropping into soaking pits removes the

most of the remaining oxide. This product may be melted in the open hearth for making steel or in a common cupola for making a superior, strong, soft cast iron.

The Construction of Aerial Telephone Lines—VI.

By Arthur V. Abbott, C. E.

POLES.

THE rapid extension of telephone and telegraph plants and the demands upon the timber resources of the country by wood-absorbing industries, raises so serious a probability of the early exhaustion of the supply of poles, that line constructors are anxiously casting about for both new supplies of timber, and for methods to increase the life of those which shall in the future be erected. Year by year the price of poles rises, and so rapidly that this factor in the cost of open wire lines is now becoming a most serious problem in telephonic installations. Of available woods it is usually considered that northern cedar or pine yields poles which are the most durable and the strongest. But on the Atlantic coast the supply of such timber is nearly exhausted and cedar and northern pine poles can rarely be obtained except by importation from the forests of the Northwest. In lieu of pine and cedar a great deal of chestnut is being used in New England and the central middle states. On the whole chestnut is a fairly good wood for poles, but it lacks the strength and solidity of pine and cedar. The chestnut as a tree is much slimmer than the pine or cedar and consequently the butt of the pole has considerably less resistance than with the other woods. As chestnut can be obtained in fair quantities at reasonable prices throughout Massachusetts, Connecticut, New York, Pennsylvania, Delaware and Maryland, a very large proportion of lines recently constructed, particularly those of moderate height, say 35 to 40 ft., are built of this material. The Southern States should apparently afford an inexhaustible supply of pole line material in yellow pine timber. But experience has shown that notwithstanding the pitchy quality of that wood, yellow pine rots with most alarming rapidity when cut and set in the ground. It is commonly believed that yellow pine poles unprotected will not last more than four or five years. From the District of Columbia southward to and including all of the Gulf States, southern cedar, so called, usually really juniper or cypress, is chiefly employed for pole lines. In the Middle West, Norway pine cut in the forests of the Northwest, or on the edges of Canada, is common, and makes excellent timber for open wire lines, but is now rapidly rising in cost.

The question of treating wood in some manner, to withstand the ravages of decay, has occupied attention for years, and many methods have been proposed. Of all the processes, creosoting is the only one which has made extensive headway, and from which the results appear, on the whole, to be worthy of attention. Under the paragraphs treating of conduits a description and specification for creosoting lumber, to prepare it for use as duct material, is given in detail, and the treatment for poles differs in nowise from that there described, excepting that it is possibly unnecessary to inject quite so large a quantity of oil per cubic foot of timber, as is desirable in underground work. The chief objection to be urged against the creosoted pole is its expense. In a general way the cost of creosoting may be estimated at about $20 per 1,000 ft. board measure, or in other words, this process very nearly doubles the cost of the pole. There are plenty of reliable records showing that creosoted poles and cross arms, if properly treated, will have a life of from 18 to 30 years, while untreated wood, in similar locations, cannot be depended upon for more than 10 or 12 years. A conservative estimate assumes that creosoting will certainly double, and probably triple the life of the pole line. But decay is not the only destructive force which operates against the pole. The impact of passing wheels may damage a creosoted pole as much as an untreated one. The sleet storm is no more a respector of a preserved pole than one unpreserved, nor does creosoting materially strengthen the pole except in so far as it may prevent a decay which weakens; and in city lines the progress of urban development may render the substitution of underground lines for aerial ones imperative long before even an untreated pole will fail through natural causes. In 'cross-country lines the normal increase of business may demand so many additional circuits as to necessitate rebuilding the line from the standpoint of required increased capacity before its lifetime is over. Thus in considering the relative advantages of treated and untreated line material, it is necessary to remember that rotting pure and simple is by no means the only reason that compels a reconstruction of the wire plant, but a pole line built of creosoted timber, wisely designed in a location where it is likely to remain undisturbed for a considerable period of sufficient strength to resist the elements and with capacity to meet all probable demands is a sagacious investment, and where it is possible to realize such conditions, the treated pole is by far the best material to select. As decay takes place most rapidly close to the ground level, about one foot above or below this point, it would seem superfluous to treat the whole of a large pole in the endeavor to save such a small portion from rotting. Many attempts have been made to invent a local treatment which would be satisfactory, but so far none of these efforts have succeeded in accomplishing their object, for all forms of local treatment which have been sufficiently efficacious to prevent decay at the ground surface have been attended by so much greater expense as to nullify the attempted saving. As yellow pine poles can be obtained at a considerably less price per pole than northern timber, the expense of creosoting is not so burdensome, when yellow pine is used as in the case of the other woods. So, for all these reasons the process of cresoting is steadily making headway, and within the last few months more than one telephone company has installed its own plant for the treatment of pole line material and report favorable results.

One or two suggestions for local treatment, which involve very little expense, are worthy of some consideration. Poles, which are carefully shaved, then thoroughly charred over a hot fire, and while hot soaked in tar, last perceptibly longer than those which are set without such precautions. A plan has just been suggested that involves setting the pole in a kind of socket, slightly larger than its diameter, which may be made of either a piece of iron or vitrified pipe or a cylinder of concrete, and filling the space between the socket and the pole with an asphalt concrete. By allowing the socket to extend a few inches above the ground it is hoped that the surface decay will be prevented. This idea looks hopeful, but there is as yet no experience therewith.

Owing to the greater scarcity of timber in Europe than in America, much more attention is there given to methods of preservation and to the construction of metal poles than in this country. Other processes for timber preservation, such as kyanizing and similar methods, based upon the injection into the timber of salts expected to coagulate the vegetable albumen, and thus preserve the wood from decay, have attained much greater currency and meet with much more favor abroad than in America. The use of structural iron poles, built either of wrought iron pipe or of a combination of angles and channels, is widely in vogue. The majority of European cities insist upon pole structures which are architecturally far superior to anything we here possess, and of a much more durable character. America, however, has developed the conduit system to a very much greater extent than has been adopted in European practice, and it is probably for this reason that the structural iron pole has not here received the attention it deserves. In street railway work iron poles, where trolley lines are permitted in business districts, are almost universal, and there seems to be no good reason why the telephone and telegraph companies should not follow a similar example in their most important lines. An ingenious inventor has suggested a plan for repairing pole lines, which decay has already rendered insecure. He proposes to saw off the pole square, as close to the ground as possible. Then to extract the rotten stub and to replace it with an artificial butt of concrete, to which the pole is subsequently bolted, by means of 4 or 6 iron straps. Certainly this is a novel expedient, and where lines are not subjected to great bending moments, may have some value, but it has been shown that the greatest stress on the pole occurs at the ground surface, hence the impossibility of designing any kind of splice at this point which will confer any sensible amount of strength.

But omitting from consideration all preservative processes, the telephone company should exert strenuous endeavors to secure the best possible timber for poles. There is no better method than to have the standing trees examined by an inspector, somewhat skilled in forestry, and withal a good line man, with a knowledge of the kind of poles necessary for the particular job under consideration. The accepted pole should be marked, and only felled during the three winter months when the wood carries the least sap, for poles cut in spring and summer decay much more quickly. As soon as on

the ground the poles should be trimmed, cut to the required length, peeled and roofed. They should then be stacked up on skids, away from the earth and allowed to season at least for a year, prior to setting. Unfortunately, only the largest telephone companies can afford to carry a sufficient stock to justify so careful a selection, and the majority must content themselves with poles purchased from a dealer, who probably does not endeavor to do anything beyond supplying poles, which approximately correspond to the specifications for length and top and butt circumference, and cases are on record where standing poles have, within a week, been doing duty in a working line. Consequently, a lot of very poor material is creeping into pole lines.

Municipal Ownership Convention in New York.

A convention described as "National" was held last week at the Reform Club, New York City, to consider municipal ownership and public franchise questions. While some of the papers and discussions were important and valuable, the public interest was at no time striking, and the attendance never appeared to reach more than forty or fifty, of which number, if applause is any indication, several were "cranks" in favor of undiluted socialism. In fact, the more extreme the statements or arguments against individual enterprise or private ownership of anything, the louder and heartier was the applause elicited.

The first paper was read by Prof. Joseph F. Johnson on "Recent History of Municipal Ownership in the United States," prepared under the direction of the late Charles Waldo Haskins, Dean of the New York University School of Commerce. It called attention to the backwardness of this country in municipal ownership, and in the matter of gas lighting said that Philadelphia was the only large city which owned its gas plant. Of street railways, the paper said that out of 928 companies reported in this country only one, in Grand Junction, Colo., was owned by the municipality.

The necessity of some relief from the charges of private corporations was urged, with the Consolidated Gas Company, of New York, as an example. The paper stated that in 1902 this company, after paying all fixed charges and 8 per cent. on its stock, put aside a surplus of $2,100,000.

"The demand for municipal ownership is finding an outlet in the growing agitation for franchise taxation. Dr. Whallen, the Sociology Librarian of New York, in a published discussion of this subject, states there are but two bases of taxation—net income and actual value. Two noticeable efforts to increase the taxes of corporations are the Illinois Supreme Court decision of October 24, 1901, authorizing the Board of Equalization to assess gas, traction and other corporations at fair cash value, thus increasing the returns demanded by the Chicago Teachers' Association; and the work of Tom Johnson's new board, which raised the assessment of railway, gas and electric companies $17,000,000, resulting in a reduction of the tax rate from 3 per cent. to 2.6 per cent."

Mr. C. R. Bellamy, general manager of the municipal street railways of Liverpool, read a paper in person on the subject. Facts, as shown in Liverpool, said Mr. Bellamy, proved more than any amount of speculative opinion. In 1897 a company rented the city's tramway lines, which belonged to the municipality. The service was inadequate. The city bought the concern's rights for $2,723,400. Electric traction was adopted throughout the system, and other improvements were made. The carrying capacity was doubled. This table was quoted to show the results:

	1897.	1902.	Percentage Increase.
Passengers	58,409,084	109,335,585	184.66
Mileage	6,013,180	11,790,815	96.08
Receipts	$1,395,552	$2,431,320	74.25

"The city had developed its system so that many times more passengers were transported annually than under the company's management. The city had grown until it had a population of 700,000. A unit fare of 1 cent had been established, carrying a passenger an average distance of two and a half miles, and a large percentage of passengers were obliged to pay only this small fare, the double fare for long rides not affecting many travelers. In the last year of the company's old horse traction the fatalities had numbered 8 out of 6,000,000 passengers; under city regulation the number had come to be 8 out of 13,000,000."

Mr. Bellamy continued: "Reviewing the position as between company and municipal control, in the case of Liverpool, which may be taken as typical of the large British towns, it may be pointed out, first, that no one is suffering by the change, the share and stockholders, directors and officials having been bought out, or compensated on ample terms. The competition with the local railway service has been helpful to the citizens, and will lead the railway companies to a better organization. The gain to the traveling public during last year amounted to £320,000 (or $1,536,000) as a result of lower fares. The employees gained £40,000 (or $192,000), with free uniform clothing. Notwithstanding these important concessions, the gross profits amounted to 9½ per cent., after maintaining the rolling stock, permanent way and machinery in the highest state of efficiency. Six per cent. of this amount has gone to interest and sinking fund, 2½ to a general reserve, or depreciation fund, and the remainder, amounting to £25,000 (or $120,000), transferred to the relief of the local taxes. The capital expenditure of the complete undertaking has been shown to be $8,756,280. In addition to the building up of the sinking fund, which will extinguish the debt within twenty-five years, a renewal or depreciation fund of nearly $1,056,000 has been set aside, an amount equal to 12 per cent. of the capital, which will continue to grow."

Mr. Bellamy had to answer many questions. He said they did not have the crowded car trouble in Liverpool, as the cars were double-decked. Two-thirds of the year was warm enough to make outside riding comfortable. In winter the Traction Committee allowed nine passengers to stand up inside, but the tenth had to get outside. It was planned, however, to close the top decks for protection against the weather.

The Traction Committee of the city, he said, was composed of eighteen members, appointed by the council. He himself had sole power of all appointments in the service, and there were some examinations, always subject to his prerogative. The limit of speed fixed by law was ten miles.

Mr. C. T. Yerkes presented a paper against public ownership of street railways and said:

"There are several reasons, however, why I am sure that municipal control should rarely exist. First, all business ventures should be taken hold of intelligently and with due consideration for economy. How ridiculous to think that a municipality could run a railroad economically or wisely. The people who are connected with our railroads are with few exceptions men who have been brought up at the business, many of them having large interests in the companies. The little details are understood, and everything done to the ends that the roads may be profitable. Economics are practiced, extensions are well considered, improvements are carefully looked into and the business is carried on in a profitable and economical way. Can we for a moment imagine one of our railroads being managed by our city council or the state legislature?

"The results would be really amusing if they were not so serious. And I now ask the question, 'Who owns our railroads?' and I answer, 'The people.' I may safely say that millions of the population of our country have interests in our railroads throughout the land. They are, however, that class of people generally who have earned the right to that ownership. I fail to see any attempt at municipal ownership, in Europe particularly, but is a failure as considered with what it might be with private ownership. Take Glasgow, for instance, which is looked upon as being one of the best instances of municipal ownership in the world, and we find the expenses of construction and operation amounting to such a sum as would shame any private corporation. And the people who are in charge of the Glasgow works are most honorable gentlemen, and I believe did the best that their abilities permitted.

"We look through Europe and find railroad lines operated by the government, and where such is the case we can rest assured that the operation is not only most expensive but extremely poor. Who would have the hardihood to think that if we had had municipal control in this country for the last twenty years we would have had this great system of railroads that now exists? It is a fact that every state by its laws promotes the growth of railroads and encourages private ownership and makes our country teem with the rails and its accompaniments. That this private ownership can be abused there is no doubt, but what cannot be? No matter what the abuses have been as relates to this country, it is far ahead of anything like municipal control."

Mr. R. P. Porter presented an interesting paper on municipal versus private ownership. He said that he had been asked to discuss for the convention that boundless field of municipal activity which

is prepared to make the British citizen the constant subject of municipal solicitude from the time when in his cradle he is fed on municipal milk to the day when his remains are reduced to ashes in a municipal crematorium. Besides the numerous industries at present being carried on by British municipalities, applications have been made to Parliament for powers for the manufacture of steam engines, dynamos, gas and electric fittings, paving materials, cold air storage, ice manufacture, milk supply, stores, saloons, hotels, bicycle tracks, etc. Street car factories had been established, municipal telephones were being undertaken, and a system of fire insurance is being discussed. Municipal banks, municipal pawnshops, municipal bakeries and even municipal collieries had been seriously proposed. To the common place duties connected with public health, streets, policing, protection from fire, etc., must be added all the more intricate businesses. These industries, he said, must be carried on at the risk of the ratepayers, by representatives not elected because of special experience, but because of party affiliation.

"The rush of English municipalities into speculative enterprises," Mr. Porter said, "has resulted in an enormous increase in local indebtedness. Last year sanction was given to loans amounting in the aggregate to no less than $144,677,465, and the average amount added in each of the last three years has been only just short of $125,000,000. Never before has there been any approach to these figures. In 1891 the sum was $37,021,495, while the average for some years previously had been about $25,000,000. In 1875 the English local debt was about $20 per head of the population. It is now over $50. While local indebtedness in the United Kingdom has risen from $464,100,500 in 1875, to $1,469,320,000 in 1900, and stands at $1,650,000,000 at the present time, per capita increase of from $20 to $50 per head of population, the aggregate per capita debt of the 137 largest cities in the United States has decreased from $56.62 in 1880 to $48.05 in 1902."

Omitting New York, where the per capita debt had remained about stationary while the assessed value of property had more than doubled, Mr. Porter said that in the thirty-five principal cities of the United States the net per capita debt had decreased in twenty-two and increased in thirteen, the increase in four out of the thirteen being only slight. In the same period the value of taxable property had more than doubled in many cities and had in some increased threefold. A similar comparison of a like number of the principal British cities showed an increased debt per head of population in nearly every case.

It seemed evident, he said, that the results of municipal trading in England had greatly increased debt, not only actually but relatively to the assessed ratable values and per head of population. "The excuse offered for the enormous increase of local debt in England," he said, "is that a considerable part of it has been contracted for productive industries. But the profits from many of these concerns, under municipal management, are very small indeed. The only reliable estimate on these profits may be found in a paper by the president of the Royal Statistical Society in which he showed that on a borrowed capital of $416,895,000, with an average annual income of $44,490,000, upon which only the sum of $405,835 had been set apart for depreciation, or about ⅛ per cent., there was an average net profit for the five years ended March, 1898, of $1,851,705,000, or about ½ per cent. on the outstanding debt, which the local government board then put at $359,415,000."

Mr. Porter went on to point out that public utilities in the United States were far ahead of those in England. In England, as elsewhere, the private companies set the pace in enterprise, he said, and even in reducing the price to the public. This was true of gas plants. Municipalities, he said, had not been known to lead in enterprise. The street railways of England, where about half are owned by municipalities, were not nearly comparable, he said, with those in the United States. Great Britain, he declared, would have had 4,000 or 5,000 miles of first-class electric railways by this time, but for the stifling effect of municipal trading. In conclusion, Mr. Porter said a municipality could work no cheaper than private enterprise, and a city council, constantly changing its membership, was not superior, as a board of management, to the directors of a successful company. With municipal ownership, he said, employees must always be retained at high wages.

"It would go ill at the next election with any one who suggested that they be discharged because they are useless, or that expenses should be cut down," Mr. Porter added. "The Birmingham City Corporation now employs over 7,000 men, and the street railways, if taken over by the city, would employ 1,500 more. The servants and officials of the Glasgow Corporation are put at about 15,000. Well organized, such groups must have great influence in municipal elections. Reflect for a moment what an organization like Tammany would become if, in addition to the present force of officials an army of industrial employees should be added. These are not imaginary but real dangers from the adoption of municipal ownership and operation. The establishment of enormous bureaucracies and the creation of a privileged class of employees would constitute a menace to the public weal."

Mr. Robert Donald, of London, on the subject of "Municipal Ownership of Tramways in British Towns," said in part: Almost all the large cities (Great Britain) not only own but operate their own tramways. The London County Council is operating 72½ miles and is building 100 miles. Glasgow owns and operates 103 miles, Liverpool 90. Edinburgh owns lines and a company operates them. Companies are confined to the smaller towns in England and Scotland. One of the elements which helped forward the municipalization movement was the bad management of companies which allowed their undertakings to become dilapidated towards the latter end of their leases. They paid their workmen so disgracefully that there were serious strikes. Cars were dirty, horses bad, service irregular. The advantages of municipal ownership are considerable. It regulates fares, provides for workingmen's cars, and fair treatment to employees; all this besides a yearly rental when the lines are leased. Local civic pride and jealousy, however, prevent co-operation between municipalities on a large scale. In Glasgow the aim of the municipality has not been to make a profit in relief or local taxation, but to carry the greatest possible number of persons the longest possible distance at the lowest possible fare. By the end of the present year most of the municipalities will have complete systems of electric traction and in almost all large centers of population municipal ownership of street railways is likely to be extended. The scope for private enterprises will be confined chiefly to linking towns together and opening up rural districts.

Mr. Donald gave the subjoined statistics as to municipal and private roads:

	Municipalities			Companies		
	No.	Capital Expended. £	Mileage.	No.	Capital Expended. £	Mileage.
1882-3	28	2,227,192	170½	113	7,523,635	501
1888-9	29	2,959,633	243¾	125	10,704,958	706¼
1892-3	35	3,105,636	274¼	118	10,998,516	686½
1896-7	42	4,459,488	367¾	117	10,405,622	663½
1897-8	47	6,116,687	450	116	10,376,282	614
1898-9	61	8,134,530	519½	108	10,468,692	602½
1899-1900	70	10,203,604	584¾	107	11,532,284	592¼
1900-1	99	14,057,664	689½	114	12,741,359	616

While public bodies, at the end of that year (March, 1901), operated only 27 per cent. of the total undertakings, they earned 43 per cent. of the aggregate net revenue and carried 46 per cent. of the total number of passengers conveyed. Since 1901 the greatest development in municipal tramways has taken place, while many of the companies figuring in the above returns have been expropriated.

On the subject of electric lighting, an elaborate paper was presented in manuscript by Mr. Victor Rosewater, of Omaha. Mr. Ellicott, city electrician of Chicago, also defended the work done there. Mr. J. B. Cahoon, past president and secretary of the National Electric Light Association, read a pithy analytical paper on the subject and said: Each community or municipality may do as it seems best in the matter of lighting its streets; may either enter upon the business itself or contract with a private corporation to furnish it with the necessary lights. The great majority of cities in this country still continue to let out the contracts for this work to private corporations and on the whole this has worked satisfactorily. The big plant in Chicago is only doing about 12 per cent. better than the average of the small plants throughout the State, when we might fairly look for 30 per cent. In other words, if by operating a big plant with approximately a capacity of 5,000 lamps, it cannot show a better economy than 12 per cent. over the average country plant in the same state, we may fairly assert that this plant has failed to effect any saving to the city by operating its own plant.

If we municipalize electric light plants we take away the incentive to progress towards a cheaper method of production and a cheapening of the price accordingly; for it is a well-known fact that where municipalities have started into any such enterprise so far as they were concerned progress ceased. Electricity is by no means

fully developed, and the only way to make further improvements is by private companies forcing the manufacturers to improve apparatus.

To-day the old electric light companies are heavily capitalized, not from injecting water into their securities, but from the fact that they have paid the usual penalty for entering a new field. They paid high prices for the original apparatus. In a short time this had to be replaced by a better grade, and this in turn has had to be replaced by modern apparatus. What profits were made were promptly paid out in dividends, and nothing was set aside for the replacement of apparatus. Depreciation was never thought of; hence the burden on the electric light plant is much heavier than on any other form of manufacturing plant. We do not want to stop progress in the electrical fields and fall behind the world we are now leading.

I think the great trend of all arguments on the municipal ownership question in the past has been along the lines as to whether the municipal plant can be operated so as to furnish lights for a city at a less cost than the existing company can furnish them. I say frankly that the municipal plant cannot furnish light at as low a cost, all things considered, as the city can obtain from the local private company.

Mr. Rosewater's paper said: We are told that even if it were possible for the municipality to effect a large financial saving for its taxpayers and private consumers of electric light, and to secure for them the increment accruing from the steady growth of population and business which, for the private corporation, is absorbed in the franchise value, political exigencies would stand in the way. The bugaboo of politics is always handy for use upon timid people or those who merely seek for an excuse. Establish municipal ownership by the acquisition of an electric lighting plant, declare its opponents, and it is at once dragged into politics. That with proper civil service regulations the plant can be operated without undue political interference is certainly a possibility, and that the acquisition of such a plant would exert the strongest influence for protecting the public service from the bane of politics, is no more than reasonable to expect.

On the other hand, who will deny that the private electric lighting corporations are constantly in politics. The regularly recurring necessity of securing new franchise grants, of barring out competitors, or heading off hold-ups, of renewing contracts for street illumination, almost compel each privileged corporation to be active in politics in order to claim favors from the powers that be. In every city of any pretentions in this country the franchised corporations constitute the most pernicious factor in local politics. They have a community of political interest that draws them together, and they exert themselves as a rule in political contests on one side or the other with their consolidated strength.

The real question is whether it is better for the municipality to operate its own electric lighting plant or reserve to itself only the right to regulate, with compensation for the franchise either by fixed money payment or profit sharing arrangement. If financial considerations alone were to govern, the answer would depend upon the terms agreed to, although it is hard to see how, if the city may rightfully claim part of the profit on the percentage plan, it may not with equal propriety and justice, do the work itself and take it all.

The city owes it to its citizens who may be private consumers of electric light to protect them against exorbitant charges, and it can do this best when it is alone interested as owner and operator. Municipal ownership of electric lighting may have to wait its turn among the many demands urgently pressing upon the resources of American cities, yet no progressive programmes of contemporary municipal reform will, without it, meet the requirements of current popular thought.

Mr. Fred. F. Ingram, electric lighting commissioner of Detroit, made a statement very favorable to the municipal plant there, but quite refuted in every detail by the analysis given in these pages last week, so that to repeat them would require a reprint of that five-page criticism of the recent annual report of the commission.

Dr. Charlton T. Lewis made a vigorous argument against municipal business and in favor of private ownership and management. "Personal initiative, individual self-respect, the independent thought of the free man—these are all utterly inconsistent with paternalism in government." As to debauchery of the electorate, he said: "The merest glance at the body of voters in any of our great cities is conclusive. In New York, for example, the taxes are borne almost wholly by the owners of the soil. These are much less than one in twenty of the voters. The city government, by its taxing power, draws its supplies directly from less than 5 per cent. of the population. It disburses these vast revenues at the will of the entire body. Now it is not in the end the interest of any large body of citizens that extravagance and corruption should prevail in the government. The average family in the city suffers serious loss and injury from such conditions. But the number of voters who, in their immediate daily wages, in salaries, in favors obtained by political influence, in peculations and benefits, direct or indirect, profit by extravagance and corruption in the administration, is several times as great as the number of those who pay the taxes. In other words, for every business investment of enterprise which we put into the hands of a municipal government, we are increasing the power and the temptation of those who are not taxpayers to take unjustly from those who are. We are bribing voters against reform. We are creating a vast and permanent corruption fund to prevent our local elections from resulting in a pure and efficient administration. As long as this condition of affairs remains every such proposition is a blow aimed at the foundations of our institutions."

Mr. Thomas Fulton, secretary of the Citizens' Union, told of the investigations he had made of municipal affairs in this city, and of the great waste of public moneys they had revealed to him. "I find that a large proportion of the employees of this city work from thirty-five to forty hours a week, not deducting holidays or vacations. Thousands of our employees actually work about twenty-five hours a week the year round, deducting holidays and vacations, and they give very inferior service at that. The present government very rightly stands for the eight-hour day. Trade unions were responsible for it. It means eight hours of actual labor. I would respectfully point out to the present administration that eight hours does not mean seven or six or five hours, any more than it means nine or ten hours. The heads of the departments work hard and many hours, but too little of their time is spent in seeing that other people work. We are spending more money than ever, and with proper supervision the government ought to be run at 75 per cent. of the present outlay."

On the question of the public or private ownership of telephones a spirited controversy arose. The introductory address on this subject was made by Mr. U. N. Bethell, general manager of the New York Telephone Company, on the topic, "The Superiority of Corporation Ownership of Telephones." A number of statements made by Mr. Bethell in support of his position were controverted by Prof. Frank Parsons of the Boston Law School, who, going over the same ground that Mr. Bethell had traversed in his address, drew entirely different conclusions. There is a general impression in electrical circles that Mr. Bethell is an absolute master of his subject, as well as a model of fair and direct argument in his discussions of the subject.

Prof. Parsons favored municipal ownership. He submitted charts showing reductions in the cost to the public where independent concerns had entered a monopolized field, and said that greater reductions could be made by the municipalities. A paper, prepared by A. R. Bennett, on "European Experience of Public Ownership of Telephones," was read by the secretary. Mr. Bennett is engineer for Glasgow and other British municipal telephone systems. Several of these papers are of interest, as well as the discussions, but reports or copies are not at present available for publication.

Allan Ripley Foote, editor of *Public Policy*, spoke of the "Regulation and Taxation of Public Service Corporations." Among the other speakers were John R. Commons, secretary of the Taxation Committee of the National Civic Federation; Raymond V. Ingersoll, George H. Shibley and Eltwed Pomeroy, the subjects of the last two being direct government by the people through the initiative and referendum. After Mr. Ingersoll had defended labor unions and mentioned "scabs," Dr. William Henry Hale, a lawyer of Brooklyn, rose and said that he was surprised to hear a man like Mr. Ingersoll use the word "scabs." Not long ago, said Dr. Hale, he painted his own fence in Brooklyn. It took him one day, whereas a union painter employed by a neighbor occupied a whole week painting the same sort of fence in no better style. Then, he continued, as he worked late at his painting, a painter walked up to him and threatened to report him to the union for painting after union hours. "And it was my own fence!" said the speaker. "The tyranny of labor is worse than the tyranny of capital." The last sessions of the convention were given up chiefly to a discussion of franchise questions.

New Brooklyn Rapid Transit Power Station.

The Brooklyn Rapid Transit Company will soon add to its electrical generating system a new power house, now approaching completion. At present there are four main generating plants, aggregating about 22,000 kw. The capacity of the new station will be 32,000 hp, part of which will, however, be in substitution for that of obsolete generating apparatus in one of the older stations.

The new power house, known as the "Central Station," is located at Third Avenue and First Street. The accompanying illustrations show the building and the interior of the generating room in its present condition. The engine room will contain at first six 4,000-hp units, placed in rows of four each, leaving space for two more units, which at present is occupied by two direct-current railway generators.

The boilers, which are of the water-tube type, are arranged on two floors, there being thirty-two 650-hp boilers in all, with coal storage above. The condensers are furnished by the Worthington Company, as are also the air pumps and other auxiliary apparatus relating thereto. The engines were built by the Allis-Chalmers Company, and are of the vertical marine type of 4,000-hp rated capacity each, directly connected to Westinghouse 2,700-kw generators. Although the most economical cut-off for the engines is at 4,000 hp, the guarantee calls for efficient working at 6,000 hp, and the generators are also guaranteed to operate successfully under 50 per cent. overload. Six of these generators are of the three-phase alternating-current, revolving-field type, generating current at 6,600 volts and 25 cycles, and the other two are Westinghouse railway generators, delivering current at 575 volts. The steam pressure is to be 175 pounds. There is a 50-ton traveling crane with a 10-ton auxiliary hoist, which traverses the entire length of the engine room. Coal-conveying apparatus is to be installed in duplicate, and will have a capacity of moving 125 tons of coal per hour. This limit being made by the capacity of the coal tower on the receiving dock. Ashes will be handled by means of an electric locomotive and hopper cars.

This station will supply five sub-stations, of which four are now erected, namely, the Tompkins sub-station, located at Tompkins Avenue and Fulton Street, which serves the central portion of the system; the Halsey sub-station, which serves the eastern district;

FIG. 1.—VIEW OF EXTERIOR OF NEW CENTRAL STATION.

the Essex sub-station, which furnishes power to the East New York district, and the Coney Island sub-station, which takes care of the large summer excursion business in that direction. There will be a fifth sub-station in Flatbush, which has not yet been commenced. This station will be near the Brighton Beach line and will supply power to the district now supplied by the Thirty-ninth Street power station. The total proposed rotary capacity of the sub-stations is as follows: Essex sub-station, 2,000 kw; Tompkins sub-station, 3,500 kw; Halsey sub-station, 7,000 kw; Coney Island sub-station, 3,000 kw.

All of the transformers and rotary converters in the sub-stations, as well as the switchboard apparatus, were furnished by the Westinghouse Company. The Halsey sub-station equipment consists of five 1,000-kw rotaries. This station also contains a booster made from two direct-current generators that were saved from a fire in one of the company's power stations a year or two ago, and which have been rewound for this service. In the view of the interior given in the illustration below this booster can be seen on the left, while on the right is shown the method of starting the rotaries by means of an induction motor. Throughout the entire system the rotaries are started in this manner. The Essex sub-station consists of a combined storage battery and rotary converter

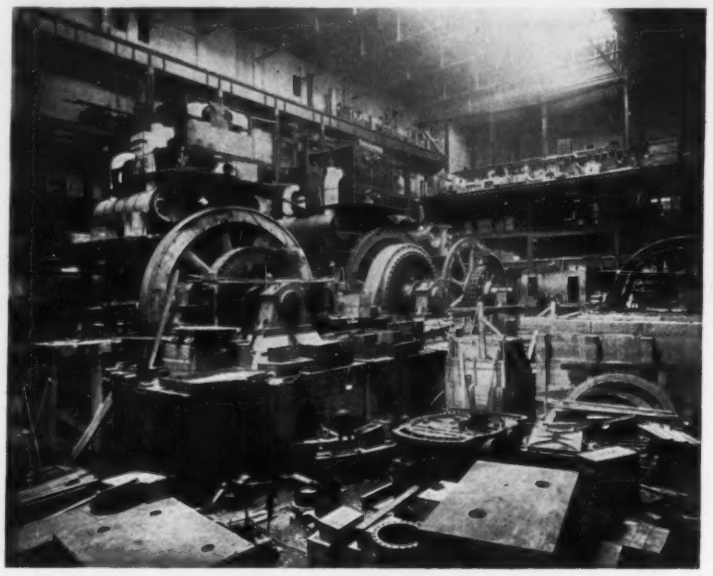


FIG. 2.—VIEW OF INTERIOR OF GENERATING ROOM.

station. The storage battery rooms are behind the rotary room, the rear part of the building consisting of two stories, both being occupied by the batteries. The present capacity of the Essex battery is 2,000 amp-hours. There has been installed one rotary converter of 1,000 kw capacity, and there is accommodation for three other rotaries. The Tompkins sub-station contains two 1,000-kw rotaries and one 500-kw rotary. The Coney Island sub-station is already equipped with its full complement of 3,000 kw, containing one 1,000-kw rotary and four 500-kw rotaries. This station is a very important one, although it serves a territory upon which only the summer traffic is heavy. It has been the custom to help out this part of the road by means of a portable storage battery, contained on old elevated cars, which could be moved from one part of the system to another, being used at East New York during the winter and at Coney Island during the summer. These cells have now been permanently placed at the Essex sub-station, as the completion of the Coney Island rotary sub-station has given sufficient current supply to this section of the system. It is the intention of the company to move a part of these rotaries to other sub-stations during the winter months to take care of the car-heater load. This will keep the equipment in use throughout the year and relieve the road from paying fixed charges on idle machines.

There will also be erected a 6,000-kw sub-station near the Brooklyn terminal of the Brooklyn Bridge, and to be known as the Bridge sub-station. The conduits for the high-tension feeders leading to the station have already been laid, four 1,000-kw rotaries, the initial equipment, have been ordered, and the station is expected to be running before next winter.

A temporary sub-station has recently been constructed near the site of the permanent Bridge sub-station. It consists of a wooden building about 30 ft. x 50 ft. The walls are covered on the inside with asbestos board and the roof is of tin. This sub-station has been built during the last few weeks, and will receive high-tension current from the Edison Illuminating Company, which until recently was not available. The railway has been buying all the power it could get from the lighting company for many months, and this temporary sub-station will be used to handle any that may be set at liberty by the operation of the new power station, or such additional as can now be spared from the lighting circuits. The Manhattan and Brooklyn illuminating companies are connected by three-phase cables laid across the Brooklyn Bridge. One of these cables has been cut, and both ends are connected to the switchboard of the

temporary sub-station. The controlling switches are so arranged that current can be obtained directly from Manhattan, directly from the Brooklyn power station, or the two ends can be joined, and the illuminating companies work without connection with the railway circuits. The present installation of the sub-station consists of one 1,000-kw Westinghouse rotary and three 400-kw transformers, but this is expected to be duplicated in the near future.

Axle Train Lighting.

The topic considered at the February meeting of the American Institute of Electrical Engineers was "Axle Train Lighting," on which subject three papers were presented describing the same number of commercial systems of train lighting. A communication by Prof. Geo. D. Shepardson treating the subject from the general engineering standpoint was also read, and will be reprinted in these columns in a following issue. In opening the session President Scott sketched the conditions applying to train electric lighting. The fundamental difficulty, he said, lies in the fact that the available methods of transforming energy and of storing electrical energy are so cumbersome and inadequate. The very difficulties are an appeal for new methods, for simple and efficient methods of transforming energy from its abundant and convenient sources into the desired form of electrical current. The motion energy of the train is almost infinite compared with the meagre amount of energy required for a few glow lamps, but apparatus for transforming, regulating and storing that energy is complicated and costly. The chemical energy contained in a few pounds of coal would be ample for the evening lighting of a whole train could it be efficiently transformed into electrical energy. An ice machine by which the heat in a pail of water could be abstracted in the form of electrical energy would illuminate a car during a long journey as a lump of ice was being frozen.

Mr. Elmer E. Sperry, in a paper entitled "Axle Lighting," announced a new system of axle lighting now in process of development. Few details were given, but the claim was made that taking the items of deterioration and up-keep, as developed by the plants which have been longest in operation and including interest and all essential factors, it can be stated that a candle-power-hour can be produced for about 68 per cent. of the cost of compressed gas, and that such gas, as now used, costs in the neighborhood of 46 per cent. more than an equal illumination in candle-power by the new system. Following is the disclosure of the system so far as given in the paper:

The sensitive moving parts may be statically balanced, freeing them entirely from any response to the vibrations, jerk and jar of the car, and rendering them entirely independent thereof. This device may be relied upon thoroughly to regulate not only the potential as deliverd to the lighting circuit under varying conditions of load and battery pressure, but also to handle the generator under all possible conditions of speed variation, reversal and change of load. Furthermore, it has been found that a number of valuable features, having an important bearing on this particular subject, and which have never before been introduced as factors, may be employed with perfect success with this system of control and regulation. Not the least of these is a constant-speed generator, the use of which cuts down the torque delivery from the axle, and thus the power absorbed from the axle, in exact accord with the demand for electricity at the time from the generator. When the battery is nearly charged, this current should be largely reduced, and its e.m.f. slightly and gradually increased. Any device which will take from a moving train only the power that is at that instant required to be developed and as the demand falls off will release all overplus of power to the train, is certainly desirable, if not positively necessary to the success of the coming train-lighting equipment. Especially is this true in view of the fact that by this device a large amount of power now wasted is not only saved but left available for traction purposes to the locomotive, which is already taxed to its utmost to meet the modern demand for high speeds of heavy equipment. Moreover, by this system the weight of battery and generators may be reduced, and the whole system rendered simple in the extreme.

Nothing is found necessary to the installation inside the car except the ordinary switch-panel for controlling the lamps of the car. In some instances, such as private and wild-cat cars, it might be advisable to install a voltmeter and ammeter or a combined single instrument which has been designed. Again, in this particular style of equipment, there has been included apparatus designed primarily to reinforce the battery when such a car is required to stand idle on a siding for a considerable length of time. This equipment allows the batteries to be charged from the ordinary 110-volt alternating current as well as direct-current service. Such service is to be had in almost any station whenever the necessity arises, thus furnishing an element of the system not met in equipment heretofore offered on the markt. In this instance the constant-speed machine does not require to take on its load at lower than its normal speed. Therefore, it is of minimum weight and size. The generator is suspended interior to the truck and no belts or other than toothed wheels are employed in driving. All parts are housed in dust-proof cases and automatically oiled, and designed to operate for long periods without attention. The generator itself is sealed and can work in snow, wet or dry with equal reliability. The heating factor is low and radiation ample to keep the temperature well within prescribed limits. The air-wash still further reduces the liability to overheat.

A paper by Arthur J. Farnsworth entitled "An Axle Light System of Train Lighting," described the system of the Consolidated Railway Electric Light & Equipment Company, of which company the author is chief engineer. The general principle of the system is the control of the output of the generator, which is kept constant by varying the resistance in the field circuit to correspond to the train speed. The regulating mechanism which accomplishes this is thrown into action by any variation of the generator current whenever the generator current varies from normal. It is designed, first, to maintain a constant output of the generator at all train speeds above the "critical speed," or the speed at which it becomes operative; and, secondly, to maintain a constant voltage at the lamps, whether they are being fed from the battery alone, or whether they are connected in multiple with both the generator and battery at speeds above the critical speed.

The generator in this system is installed upon the truck of the car, and driven from the axle by means of a belt; a regulator is installed in any convenient location in the interior of the car, and a storage battery hung in a suitable box from the car body. The generator is an iron-clad, bipolar, shunt-wound, laminated field motor. The armature shaft carries a worm operating gear and cam, which throws a switch when the direction of rotation of the armature is reversed. The polarity of the generator is thus maintained correct, independent of the direction in which the train is moving.

The regulator contains a solenoid with spring-balanced plunger to control its operation; the generator field rheostat; a small electric motor, connected by means of worm gear and ratchet mechanism to the rheostat to operate it; an automatic switch or cut-out, for automatically switching the generator in multiple with the lamps and battery at the critical speed, when the speed is rising, and for cutting it out at the same speed when the speed is falling; and a variable lamp resistance operated by the same mechanism that works the field rheostat. All the operations of the regulator are automatic.

The battery is usually proportioned to provide for about ten hours' continuous burning of all the lamps, although in the case of cars subject to long lay-overs, this capacity may be increased. Current for the lamps is thus insured under all ordinary circumstances arising in practice. Fig. 1 gives a diagram of circuits.

As the train accelerates and the generator voltage builds up, current flows through the fine wire windings of the cut-out coils and their cores become magnetized in proportion to the rise in voltage. When the voltage of the generator reaches the point where it about equals that of the battery, the magnetic pull of these coils overcomes their weight and that of the lever and resistance of an opposing spring, and the switch goes in and connects the generator in multiple with the battery and lamps. The main dynamo circuit is then complete from the generator, *G*, through a fuse, *F*, and through the solenoid, *S*, through the two coarse wire coils in multiple of a cut-out, *C*, cut-out switch, *N*, through the battery, and back to the negative terminal of the generator. If the lamp circuits are turned on, the current divides, part going to the battery and part through a lamp resistance, *E*, to the lamps, *L*. As the speed of the train increases above the critical speed, i. e., the speed where the cut-out goes in, the generator current increases in proportion until it reaches the point where the magnetic pull on the solenoid core balances the pull of its opposing spring.

Any further increase of train speed, tending to increase the current generated, will cause the solenoid spring to be overbalanced and throw into gear the ratchet mechanism, and move the generator field rheostat arm through one or more contacts until the current is cut

down to the proper amount and the solenoid plunger is again in equilibrium. A still further increase in speed will act in the same manner. A decrease in speed will cause the mechanism to act in a similar manner to cut-out resistance from the field circuit of the generator. The generator current is thus maintained nearly constant at all speeds above the critical speed.

At high train speeds, when the battery is being charged, the potential difference between its terminals necessarily increases, and to maintain the voltage at the lamps constant it is necessary to insert in series with the lamp circuits a resistance proportional to the increase in voltage of the battery above its normal discharge voltage. By means of a reach rod engaging through a roller a circular cam upon a rheostat shaft, *A*, rtsistance begins to be thrown in the lamp circuits at the same time it is first thrown in the generator field.

The regulator is adjusted in each case for the average run of the car, so that it shall maintain the generator output sufficient to keep the battery charged without excessively overcharging it. As will be

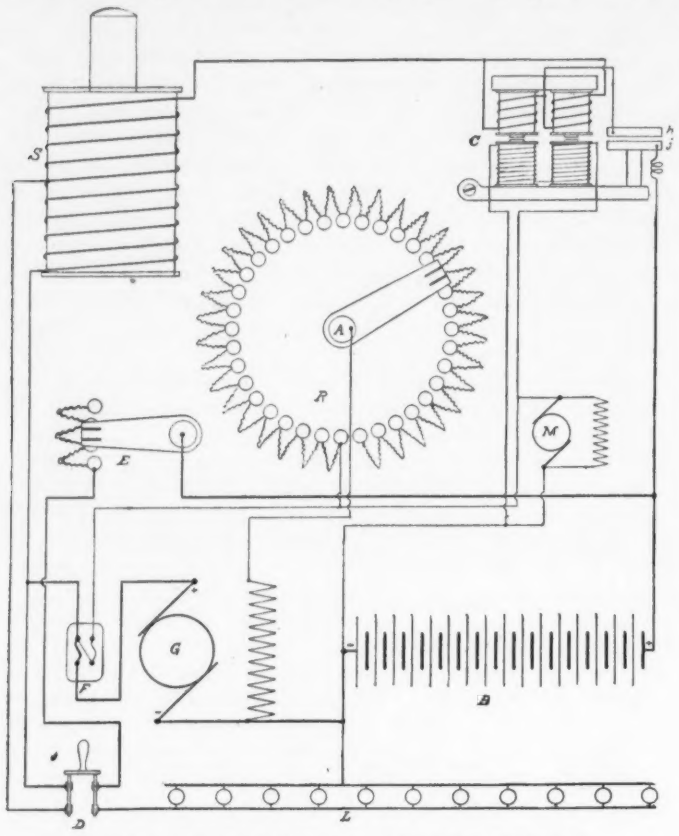


FIG. 1.—CONSOLIDATED CAR LIGHTING SYSTEM.

noticed on the wiring diagram, the series solenoid may be partially short-circuited, if desired, by means of the same switch that turns on the lamp circuits. In this manner, during the daylight run of the car, the generator output is maintained at a small amount, but, as soon as the lamps are lighted, the output instantly increases—each value of the output being maintained constant.

Except for those few moments when the lamp resistance is being inserted, the voltage variation at the lamps can easily be kept within 4 or 5 per cent.

The power required to operate this system varies with the equipment of the car, and the number of lamps it contains, and varies from one to two hp per car. It is, therefore, insignificant compared with the power developed by a moderfn passenger locomotive. There is no drag on the locomotive when starting, or until the critical speed has been reached, which, on through trains, is from twelve to fifteen miles per hour. Under this speed the armature is simply revolving with no other than frictional resistance.

The following table gives approximate data of the equipment:

Equipment.	Capacity.	Space Occupied.	Weight.
Generator	75 8 c.p. lamps.	33"x14"x13"	500 lbs.
Regulator	75 8 c.p. lamps.	17"x19"x9½"	75 lbs.
9 E Battery (Single) 24 lamps for 10 hours	160 amp. hours.	54"x20"x21"	865 lbs.
13 E Battery (Single) 36 lamps for 10 hours	240 amp. hours.	72"x20"x22"	1280 lbs.
9 E Battery (Double) 48 lamps for 10 hours	320 amp. hours.	85"x20"x27"	1730 lbs.
13 E Battery (Double) 72 lamps for 10 hours	480 amp. hours.	91"x20"x36"	2560 lbs.

The third paper, entitled "An Electric Car Lighting System," described the system of the Bliss Electric Car Lighting Company, the author being Mr. W. L. Bliss, president of that company. In this system the generator is located directly on the truck frame, and so arranged that its armature is caused to rotate by means of a mechanical connection with the axle. A storage battery carried on the car supplies the electrical energy necessary to operate the lamps whenever the armature of the generator revolves at a speed too low to render the same operative, or when the armature ceases to rotate, which condition is obviously attained when the car is at rest. Auxiliary automatic apparatus, acting in conjunction with the above, render the operation of the entire system automatic.

The motor is installed on the truck frame. Two brackets on the frame of the generator carry in roller bearings a hollow gear shaft, through which the car axle passes. Driving connection between the gear shaft and axle is obtained by means of a two-armed dog secured on the axle, and four driving springs attached thereto by means of ball-and-socket fastenings, and also to a similar dog on the gear shaft. This gives a flexible connection which allows for axial variations of the axle and hollow shaft.

The generator is of the iron-clad type, with four poles, the frame being so designed as to render the interior readily accessible with a minimum of trouble. The armature winding is of the two-circuit type requiring but two brushes. The brushes are mounted on a carrier which causes them to take up a diametrically opposite position when the motor of the car is reversed.

Fig. 2 gives a diagram of circuits. The generator switch shown is automatic in its action and completes the circuit between the generator and battery when the former is delivering its normal charging voltage, and breaks the circuit, and breaks it when the voltage drops below this point. It consists of a solenoid with two separate con-

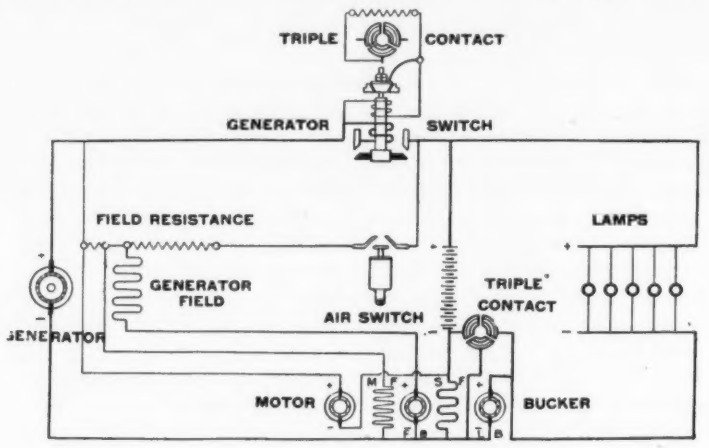


FIG. 2.—BLISS CAR LIGHTING SYSTEM.

centric coils. The inside, or lifting coil, is wound with fine wire, and is connected as a shunt across the terminals of the generator. The outside, or releasing coil, is wound with heavy wire and connected in series with the generator and storage battery. Within the central tube and free to work in a vertical direction, is a soft iron plunger, attached to and insulated from which is a laminated metal brush. When the generator develops its normal voltage, the fine wire coil will raise the plunger, causing the metal brush to make connection between two metallic contacts. The current then flows through the contacts, brush and series coil and through the battery, the series coil being wound in such a direction that this current aids the shunt coil in holding up the plunger and brush. When the voltage of the generator becomes less than that of the battery, current will flow from the battery in a reverse direction through the series coil and generator and oppose the action of the shunt coil. The weight of the plunger and brush is now sufficient to cause the opening of the switch by gravity.

Upon the top of the iron frame of the automatic generator switch is mounted a triple contact, consisting of a three-part segmental socket and a conical plug fitting the same. The plug is raised and lowered by means of a tail-rod attached to the plunger of the switch. When the plunger is down and the generator switch open, the plug connects the three segments together. When the plunger and plug are raised by the lifting coil, the triple contact is broken. The plug is insulated from the tail-rod and a flexible conductor permanently connects the plug with an insulated terminal, also mounted on the

iron frame. One lead of a resistance coil, located in the upper part of the switch-box, is connected to this insulated terminal, and the other lead is connected to the front segment of the triple contact. The negative lead of the generator is also connected to this segment. The leads of the lifting coil are connected, respectively, to the positive of the generator and the terminal to which the flexible conductor is attached. Thus it will be seen that when the plug establishes the triple contact, it also short-circuits the resistance coil. When the plug is raised, it throws the resistance into series with the lifting coil.

The resistance is thrown into series with the lifting coil; first to reduce the current and consequent heating in the coil, which would otherwise change its resistance and alter the adjustment of the switch, and second to reduce the magnetizing effect of the coil, so that less discharge current will be required in the releasing coil to open the switch, as above explained.

The function of the triple contact is to short-circuit the lamp "bucker" and series field, to be described later, thus avoiding the drop that would otherwise take place in the lamp circuit when the battery was discharging, and to render the bucker inoperative at speeds below 20 m.p.h., when the generator switch is open.

There are 32 cells of battery, and the generator is so designed that when running at 20 miles per hour it generates 64 volts. At 60 miles per hour the voltage would be 192, but regulation limits the voltage delivered to 80 volts. The method of regulation consists in generating, by independent means, a counter e.m.f. in the field circuit of the generator, which increases in proportion to the speed and voltage, and hence reduces the field current. This is done by means of an arrangement called a "bucker," consisting of a revolving shaft carrying two armatures. One of these armatures with its commutator and field, constitutes a plain shunt motor, which takes its power from the generator mains and whose sole function is to rotate the shaft. It is obvious that this motor runs only when the generator is in operation. The other armature has two windings and two commutators, and revolves in a field excited by the current flowing through the battery. This double-wound armature, with its two commutators and field, constitutes the "bucker" proper. The motor simply drives it. The winding connected in the lamp circuit is called the "lamp bucker," and the winding connected in the field circuit of the generator the "field bucker." The field of the "bucker" is referred to as the series field, that of the motor as the motor field.

When no current flows through the battery none flows through the series field, and hence no e.m.f. is generated in the "bucker"; but when current flows through this series field e.m.fs are generated in almost exact proportion to the strength of the field. No current will flow through the series field under the following conditions:

1st. When the generator is inoperative, automatic generator switch open, and no lamps lighted, e. g., car standing still in day time. 2d. When the generator is operative, automatic generator switch closed, no lamps lighted and the generator voltage equal to the battery voltage, e. g., running 20 miles per hour in day time. 3d. When the generator is operative, automatic generator switch closed, no lamps lighted and batteries discharging, carrying all or a portion of the lamp load, e. g., running 20 to 25 miles per hour at night, lamps lighted. Current would, in this case, flow backward through the series field, as the battery is discharging, were it not prevented from so doing. 4th. When the generator is operative, automatic generator switch closed, lamps lighted, and generator just carrying the lamp load, batteries neither charging nor discharging, e. g., running 25 miles per hour at night, lamps lighted.

Under these conditions, no regulation of generator or lamps is necessary. Only one condition obtains when regulation is necessary, and that is: 5th. When the generator speed and voltage have risen and the battery is being charged, e. g., running above 25 miles per hour. Then the voltage at the lamps rises and must be kept constant, whether the lamps are lighted or not. The conditions are such that the e.m.f. of the "bucker" increases in proportion to the rise of e.m.f. at the battery terminals.

The other winding of the "bucker" is connected inversely in series with the field of the generator, and generates a counter e.m.f., which weakens the field of the latter to such a degree that the e.m.f. of the generator is just sufficient at the maximum train speed to force the maximum predetermined current through the battery and series field. The regulation tends to maintain constant current through the battery and series field at a given train speed. The lamp load is carried by the generator precisely as in the case of a constant potential machine and does not affect the charging current flowing through the battery. Since the "bucker" receives or absorbs energy from the lamp circuit and the field circuit of the generator, such energy is transformed into mechanical power and tends to revolve the shaft and thus relieve the motor of that work. In fact, when the apparatus is fully loaded, the motor becomes a generator and puts back into the system about 60 per cent. of the energy consumed by the "bucker" in effecting regulation.

In this system, the generator remains connected as a self-exciting machine, and eventually furnishes the strong current in its field required to produce 64 volts at the low speed of 20 miles per hour. Separate excitation for the field of the generator, and also for the field of the motor which drives the "bucker," thus enabling the motor to start readily, is supplied by means of current from the storage battery, which current is limited to a small value by the field resistance. The circuit from the storage battery through the field resistance is controlled by an automatic device called the air switch, which is connected with the air brake system. When the locomotive is coupled the air switch circuit is closed, and vice versa. When the automatic generator switch closes, it short-circuits the air-switch, in addition to its other functions.

The discussion which followed the reading of the papers was participated in by Messrs. Scott, Carhart, Arnold, Lyndon, Bliss, von Recklinghausen, Blodgett, Henry, Hogan, Farnsworth, Lockwood, Sloan, Stott, Sperry, W. N. Smith and McElroy. In reply to further information concerning the system described by Mr. Sperry, Mr. Lyndon said that the attorneys had forbidden disclosures further than given in the paper. Mr. Blodgett described a train-lighting plant experimented with about 14 years ago on the Boston & Albany Railroad, the storage batteries being charged at each end of the line. Mr. W. N. Smith regretted that the scope of the papers was not extended to include the system used on the New York Central, Lake Shore, Pennsylvania, Chicago & Northwestern, Milwaukee & St. Paul, Northern Pacific and possibly other roads, which consists of an engine generating set supplied with steam from the locomotive, in connection with a storage battery. Mr. Bliss criticised this system and Mr. Sperry corrected a statement that it was applied to all fast trains. The Twentieth Century Limited and other fast trains have axle equipments. Mr. McElroy condemned belt and similar drives, and announced a car-lighting system which he would possibly make the subject of an Institute paper.

Several references having been made to the adaptability to train lighting of the vapor lamp on account of the wide range of voltage through which it will give efficient service, Mr. von Recklinghausen said that he feared the same problem would be met that the Cooper Hewitt Company has encountered in trying to persuade the public, especially the ladies, to consider the mercury vapor lamp a nice light. As to the lamp being put to such use under the varying voltages which are met with in train lighting, that is a thing he could not say very much about, practically nothing, except that it is a very ticklish question and not at all as simple as it may seem to be from present indications.

Russian Fire Alarms.

"In St. Petersburg, the capital of Russia, the arrangement of fire alarms is rather peculiar and decidedly unique, and the fire alarm telegraph is an unknown thing. Instead a fireman is at all times in the tower of the City Hall, and he watches the surrounding city to catch the first glimpse of a fire. When a fire is discovered during the day he runs up black balls on the top of the tower as signals; at night red lanterns are used. The number of the balls or lanterns shows the district or ward in which the fire is located," says a writer on "Foreign Fire-fighters," in the January *Cosmopolitan*. "As soon as the signal is seen by the man on duty at an engine house he rings a bell outside, which calls together the members of the company, who may be scattered over a couple of blocks. This method is not conducive to quick time in reaching the scene; and from twenty minutes to half an hour is good work, unless the fire happens to be near an engine house."

Wireless Telegraph Congress.

It is alleged that the attitude of the German Government on the whole subject of wireless telegraphy will not be defined until the proposed meeting of the international congress on the subject is held. The date of this conference is still uncertain, as the British reply to the invitation has not been received.

CURRENT NEWS AND NOTES.

IOWA TELEPHONE ASSOCIATION.—The seventh annual meeting of the Iowa Telephone Association will be held at the Savery House, Des Moines, Iowa, on March 10 and 11. Mr. Charles C. Deering, the secretary, is assured that there will be a good attendance from all over the state.

NEW GERMAN CABLE.—The German Cable Company has finished laying its second line to New York as far as the Azore Islands, 1,200 miles. The remainder will not be laid for several months, as the cable is still being manufactured. The British and German postal authorities are arranging to lay new North Sea cables, to facilitate communication between Berlin and London.

ANGLO-BELGIAN TELEPHONE CABLE.—The new Anglo-Belgian cable-telephone line has just been opened at a charge of $1.92 for a three-minute conversation. The cable connection is from St. Margarets Bay to Ostend, a distance of sixty miles. This is said to be the longest telephone-cable in the world. Paris telephone authorities say that London will be able to speak with Rome before the summer.

PALACE TROLLEY CARS.—Society women in New Orleans have begun a movement to have the street railway company put on palace cars for their convenience and comfort. They say they cannot ride in the present cars when they are in afternoon or evening dress, as the cars are dirty and there is no telling who their seatmate may be. They do not mind paying extra fares for the use of exclusive cars.

U. S. UNITS OF LENGTH AND MASS.—An amusing feature of the present controversy concerning the metric system, in which one party holds to the yard and pound as consecrated Anglo-Saxon standards, is that the United States fundamental legal standards of length and mass are the meter and the kilogram, respectively, and not the yard and pound. Owing to discrepancies found between the standard yard kept at Washington and that of the British Government, a meter made under the direction of an international committee was adopted by our government as the standard of length, and the yard is legally expressed as the 3600/3937 part of this standard. For similar reasons the kilogram was adopted as the fundamental unit of mass, and the pound is legally defunct in terms of this unit.

CHICAGO INSTITUTE MEETINGS.—The Chicago branch of the American Institute of Electrical Engineers will have a combined social and technical meeting at the rooms of the Western Society of Engineers in the Monadnock Block, Tuesday evening, March 10. A short time will be devoted to a discussion of train lighting and the remainder of the evening given over to a smoker, with light refreshments and a social time. The executive committee of the Chicago branch met February 28 and decided on the dates and subjects of meetings for the rest of the season. A number of features of especial local interest have been introduced into the programme which will be announced later. One of these will be a discussion of his report on the Chicago transportation problem by Bion J. Arnold, on March 24.

BRITISH TRAMWAYS.—An official report relating to tramway undertakings shows that in the United Kingdom, at the end of June last, there were 1,484 miles of tramway open to traffic, 885 miles being in the hands of local authorities. The capital expenditure on these lines was $125,782,680, of which $74,029,295 was spent by the local authorities. The total expenditure on capital account was $157,811,335. The number of horses employed was 24,120, of "locomotive engines" 388, and of cars 7,752. The passengers carried during the year totalled up to 1,394,452,983, and the gross receipts were $33,396,455. The net receipts were $9,307,090, the working expenses being $24,089,365. The net receipts in 1898, when there were 1,064 miles of lines open to traffic, were $5,161,155. Of 1,186 miles of lines in England and Wales, now open, 691 are worked by electricity. The rest will soon follow from present indications.

BRITISH STANDARDIZING.—A cable dispatch from London of March 2 says: The report of the Engineering Standardization Committee has been completed. Its recommendations in regard to the standardization of various iron and steel sections approximate very closely those adopted in the United States and Germany. It is estimated that the standardization will result in saving millions of pounds sterling annually to the British manufacturer and user. In structural steel alone the reduction of cost, it is said, will amount to $3,750,000 annually, and it is held that the standardization will enable the British manufacturer to deliver quicker, and to avoid the delay which has resulted in the United States securing so many locomotive and bridge contracts for South Africa and Egypt. The British Government has promised the co-operation of all the heads of departments, and is determined to enforce the use of standards, so that in an emergency it may be able to get its requirements from British firms.

ELECTROPLATING APPARATUS.—A tumbling drum for plater's use, patented to Joseph Walters, of Sumter, S. C., differs from prior devices of the kind in the minor details of construction and mounting. Its elements are the usual perforated wooden barrel mounted for rotation upon a stationary cathode shaft, the cathode conductors extending from the shaft into proximity to the periphery of the drum and into contact with the articles contained therein, and the charging door for the small articles which it is designed to treat. An unusual feature of the invention relates to use rather than structure, and consists in the portable character of the whole device, and its employment not only for the plating but for the preliminary cleaning and washing of the articles as well. The suggestion is that the drum containing the articles to be prepared for plating be first immersed and revolved in a suitable cleaning solution or in several such solutions in sequence, then rotated in water until the articles are thoroughly washed, and finally transferred bodily to the plating bath. The novelty of the conception lies therefore in the portability of the device and its use in such manner that all manipulation of the articles is avoided.

TOOL STEEL.—A report on the Taylor-White process of treating tool steel was recently submitted to the Franklin Institute by a sub-committee composed of Mr. Charles Day, chairman, and Messrs. James Christie, Coleman Sellers, Arthur Falkenau and Wilfred Lewis. The process consists of a particular method of treating steel of a particular composition, described as follows by Messrs. Taylor & White in their patent papers: "Our invention is based on our discovery that, while it is true tools made of air-hardening steels, that is to say, their cutting speeds, and also their uniformity red (though it must be understood, not all at the same temperature), it is also true that when air-hardening steels are made with certain constituents in ascertained proportions, this deterioration prevails only during a limited range of temperatures above the bright cherry-red; that is to say, from about 1,550 F. to about 1,700 F. (corresponding to a light-salmon color), and on our further discovery that above this range of temperature, which we will call the 'breaking-down point,' and from 1,725 F. up to a temperature at which the steel softens or crumbles when touched with a rod (approximately 1,900 or 2,000 F.), the efficiency of tools of such special steels, that is to say, their cutting speeds, and also their uniformity in efficiency, is greatly increased and largely so in proportion to the degree of heat to which they are raised." The report adds that to obtain a suitable steel for the process it is compounded with at least one-half of one per cent of chromium and at least one per cent of tungsten of molybdenum. The percentage of carbon has little or no effect on the result, steels containing from 85 C. to 200 C. having the same efficiency. The tool is cooled rapidly from the high heat to a point below the breaking down temperature in a lead bath, then slowly in the air or in lime. It is essential that the temperature should at no time rise, as in such case the tool would be seriously impaired. After the tool is cooled off its efficiency is found to be further increased by subjecting it to what is termed the low heat for about ten minutes, this temperature ranging from 700 F. to 1,200 F. As a result of experiments by the committee the relative efficiency of the treated steel and of the best untreated steel is placed at 3.5 to 1 on soft forgings and 1.3 to 1 on cast iron. The great uniformity of this tool steel has made possible the compilation of reliable and highly important data on speeds, feeds, etc. In conclusion, the sub-committee recommends the award of the Elliott-Cresson Medal to Messrs. Taylor & White.

WIRELESS TELEGRAPHY IN CANADA.—It is announced that the Marconi Wireless Telegraph Company of Canada will begin the erection of a wireless station at Montreal.

WIRELESS FIRE ALARMS.—It is stated from London that a fire alarm was recently transmitted from Streatham-green to Mitcham lane by Marconi wireless telegraph in advance of the regular firm alarm systems, by means of which a great saving of time was effected.

NEW YORK-MONTREAL TROLLEY.—A newspaper item is going the rounds to the effect that the first step in the completion of trolley connection between New York and Montreal has been taken by the Vermont Legislature in granting a charter to the Franklin County Traction Company to build an electric railway from Swanton to Vergennes, a distance of 72 miles.

GENERAL MEETING A. I. E. E.—At the recent meeting of the American Institute of Electrical Engineers it was announced that the general meeting of the Institute will be held at Niagara Falls June 29 to July 3. The movement to hold a joint meeting at Sault Ste. Marie or Mackinac with the American Electrochemical Society and possibly other related bodies failed, it appears, to receive sufficient support to carry it into effect.

BLACK SEA CABLES.—A dispute has arisen concerning the concession held by the Eastern Telegraph Company for a cable between Constantinople and Odessa. The Russian Government bought up the stock of the company, whose concession expires June 1. At the same time the Turkish Government has decided not to renew the concession, but to take over the line and work it by its own telegraph administration. The original agreement gives the telegraph company a preferential right, and it is on this point that the Russian Government will press for a continuation of the concession.

CONTRACTS IN EUROPE.—A cable dispatch from London of February 26 says: The Birmingham *Post,* in an article in its issue of to-day, calls the attention of British manufacturers to the fact that contracts involving the sum of $65,000,000 have been obtained by American interests during the last few weeks for the construction of electric traction systems in England, Russia and Holland. These contracts include the conversion of all of the horse tramways of St. Petersburg into electric roads, the construction of an underground railway, and the erection of sixteen iron bridges across the Neva.

SUBURBAN TRACTION IN ENGLAND.—A cable dispatch from London of February 26 says: Important conferences between the consulting engineers of all the railroads of Great Britain are being held, with the object of deciding on a uniform scheme for electric equipment, whereby the rolling stock and electric motors of the various companies will be able to travel indiscriminately on all the lines. All the trunk companies have practically decided to use electric motors, and the suburban lines are only awaiting an agreement on the subject of uniformity of plant. Six officials of the traffic and engineering departments of the London and Northwestern Railroad sailed for New York on the White Star Line steamer *Oceanic* to make a further study of American methods.

LODGE WIRELESS TELEGRAPH SYSTEM.—According to a press dispatch, a Lodge-Muirhead wireless telegraph system is about to be exploited commercially in competition with the Marconi system. The announcement adds that Marconi and others are using Lodge's invention and also one, at least, of Lord Kelvin's invention. It is stated that Prof. Lodge's new coherer, which is the integral feature of the system, consists of a small steel disc rotating in light contact with a column of mercury through an oil film. It is claimed that the sensitiveness of the coherer is remarkable, as are its extreme simplicity and freedom from derangement. Moreover, it does not require a decoherer or relay circuit. It works direct upon the Kelvin-Muirhead siphon recorder, giving, it is said, signals almost equal to the best submarine telegraph work. It is added that the submarine cable companies have so far abandoned the reserved attitude shown toward other systems as to take a practical interest in the Lodge-Muirhead system.

IN THE CASCADE TUNNEL.—Plans are in hand for applying electric locomotion to the Cascade Tunnel. The change will come none too soon, as the following incident shows: A train stalled in the Cascade Tunnel, on the Great Northern Railroad, near Wellington, Wash, not long ago, endangered the lives of every one on board. The tunnel is 13,283 ft. long, and on such a grade that a helper (steam locomotive) is required to get trains through. The helper and regular engine became separated in the tunnel, and the crews were afraid to risk proceeding with the train. The helper was sent ahead for aid, and the train remained in the tunnel. The gases from the two locomotives had so poisoned the atmosphere, however, that most of the trainmen and many of the passengers were overcome. Had it not been for an extra fireman, who happened to be on the train, and backed the engine down the mountain, it is probable that many lives would have been lost.

EXPLOSION AT EDISON CEMENT WORKS.—A serious explosion occurred this week at the Edison cement works near Easton, Pa., established by Mr. T. A. Edison. Four men were killed outright. Among those seriously and perhaps fatally burned were Mr. E. A. Darling, the chief engineer, and Mr. R. H. Goodnilley, the chief electrician. Mr. Darling was at one time mechanical superintendent at Columbia University. It appears that just before quitting time on Monday it was noticed that coal in a bin was afire. Hand extinguishers were used and it was thought that the fire had been put out. Automatic buckets carry this coal to the blower house and in this building the atmosphere is charged with pulverized coal. In some way fire in the bin was picked up by one of the buckets and as soon as it reached the blower house a crackling sound gave warning of impending danger. The day foreman seized a bucket of water to throw on the fire, but before he could do it an explosion occurred. More than a score of men were in the blower house preparing to quit work, and all were more or less injured and burned. Some were hurled through doors and windows.

MARTINIQUE-GUADELOUPE WIRELESS TELEGRAPH.—Under date of January 24, 1903, Consul L. H. Aymé, of Guadeloupe, reports: "Regular daily communication has been established between this colony and Martinique by a system of wireless telegraphy. The station in Guadeloupe is situated near to Gosier lighthouse, and that in Martinique, I am informed, somewhere on the peninsula of La Caravelle, on the east side of that island, so that the air line between the two stations passes entirely over the sea. These stations have been installed by a detachment of army engineers, and only official messages between the governors of the two colonies have thus far been exchanged. The officer in charge informs me that the system used is not the Marconi, but is one devised by the French engineer corps. The spark used is about 4 inches long, and the current is obtained from a small dynamo driven by an engine using vaporized naphtha. Four wires are used, separated at the top and bottom, forming a long, rectangular cage. The mast is said to be 170 feet high. As all cable communication with Martinique has been interrupted for several months, this is the only means of sending telegraphic messages."

ST. LOUIS EXPOSITION RAILWAY.—Mr. Charles V. Weston has completed the plans and specifications for the Intramural Railway for the Executive Committee for final modification or approval; after which the construction and operation may be undertaken by a concessionaire. The plans contemplate an elevated and an enclosed surface track. The road is to run west along the north line of the Fair Grounds from the vicinity of the northeastern entrance past the Administration Building and University group to the Athletic Stadium and Gymnasium; thence by a winding southward course past the various points of interest west of the Skinker road to the southern part of the grounds; thence bending east and north to the Art Palace; thence southeast to the Plateau of States, winding on to the Government Building and thence back to the beginning, the course touching all points of interest accessible from twelve stations. Transit over the entire route will require from twenty to thirty minutes, the trains all running one way, about one and a half minutes apart. The motive power will be supplied from the Exposition power house by third-rail system. Passengers will enter from a receiving platform on one side and leave by way of a discharging platform on the opposite side. The estimated cost is $650,000, and it is further estimated that a charge of ten cents for the round trip will pay the cost of construction and maintenance and a reasonable profit besides.

LETTER TO THE EDITORS.

Power Required to Drive Machine Tools.

To the Editors of Electrical World and Engineer:

Sirs.—The interesting article in your issue of February 21 entitled "Power Required to Drive Machine Tools in Locomotive Shops," while giving much valuable data, unfortunately omits any statement of the cutting speeds, depths of cuts and rates of feed, and the tests do not appear to include the case of the new high-speed steels. The data referred to are very necessary in comparisons and to those who would benefit from tests made; and the increasing part played by the latter material renders any information relating to it of much practical value. The conditions under which the tests were made are not so severe as in some cases which the writer has in mind, in one of which the group line shafting is running at 155 to 160 r.p.m., and in another where the minimum speed of group shafting is 200 r.p.m. It is to be hoped that tests will soon be reported covering high-speed steel, and in any event including all of the data necessary to render the tests of full value.

CHAS. P. SANDS.

MONTREAL, CANADA.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

The Air-Gap in Induction Motors.—BRESLAUER.—An account of an experimental investigation of the influence of various values of the air-gap in induction motors. It is well known that it is generally assumed that the air-gap should be very small in order to avoid a large no-load current and a large phase difference; but a small air-gap is very inconvenient for mechanical reasons. The author has made experiments to find whether an increase of the air-gap really has so great a disadvantage concerning power factor and overload capacity. He used a four-pole, three-phase motor of 240 mm rotor diameter and 110 mm rotor length. The motor had originally an air-gap of 0.5 mm; afterwards its rotor was turned off and the air-gap was thus increased to 0.65, later to 0.8, and finally to 0.9 mm. The results are given in diagrams and tables and prove that the smallest value of the air-gap—0.5 mm—was not the best one, but that an air-gap of 0.65 gave better results with respect to straying, and that even one of 1 mm is not prohibitive. The important result for practice is the fact that the conditions of straying do not become worse to the same degree as would correspond to the increase of the air-gap, and that it is possible by increasing the air-gap, to increase the overload capacity; according to the measurements this was in the ratio of 52:65, i. e., by more than 20 per cent. He remarks, however, that the stator of his motor had only two slots per pole and phase, i. e., less than what corresponds to the best construction according to modern practice, which requires at least three slots. He therefore suggests that other engineers might repeat these experiments with more modern motors. Nevertheless, he believes that from his experiments he can draw the practical conclusion that even in small motors the air-gap should not be below 0.5 mm and may be 0.6 to 0.7 mm.—*Zeit. f. Elek.*, January 18.

Testing Non-Synchronous Motors.—MEUNIER.—An article on a method of testing induction motors, similar to the Hopkinson-Potier method for direct-current dynamos. Two identical three-phase motors are connected electrically to the same network; each motor is provided with a pulley, but they have different diameters, and they are coupled together by means of a belt. When both motors are supplied with current from the network, the one motor acts as generator, the other as a motor; the relative speeds and the values of the current in the station depend upon the two diameters of the pulleys. He first describes a test in which the different currents and powers are measured by ammeters and voltmeters and gives an analytical and graphical representation of the phenomenon which take place. He then describes a method in which only ammeters are used for measuring the currents in the supply network and in the stators of the two machines; by plotting a diagram it is then possible to find the efficiency and the power factor without the use of wattmeters. This method may be useful in some cases.—*L'Eclairage Elec.*, February 17.

REFERENCE.

Non-Synchronous Motors.—ROSENBERG.—The first part of an article illustrated by diagrams, on the analysis of the no-load current of non-synchronous motors.—*Elek. Zeit.*, February 12.

TRACTION.

Passenger Traffic in Greater New York.—WHEATLY.—A continuation of his serial in which the author reviews the general condition of transportation facilities in Brooklyn, which is laid out on the radiating plan, and explains the requirements growing out of these conditions. A distinctive feature of the problem is that the city has grown into somewhat of a fan shape with long main lines tending toward and converging at a few congested points along its water front, where the business districts are located or where there are outlets by bridge or ferries to Manhattan. The chief transportation problem is to move the population not only to its own business district but also to move a considerable portion through that business district and across the East River into Manhattan. At present the transportation problem of Long Island City and the Borough of Queens has not reached an important point, but the possibilities of development with the completion of the present additional bridges spanning the East River, the building of the Pennsylvania Railroad tunnel, and the extension of the Subway, are clearly pointed out. Permanent relief can only be secured by very extensive improvements and extensions of the present railway facilities, the widening of streets, additions of tracks, inclines and other connections, and the provision by subway or elevated structures for distributing and collecting in the business districts of Manhattan, the traffic for Brooklyn and suburban Long Island without throwing the greater part of it upon the local lines. Some idea of the present condition may be gained by the statement that upwards of 300,000 passengers patronized the cars crossing the present bridge in both directions on November 10.—*St. R'y Jour.*, February 7.

Freight and Express on Electric Railways.—COOPER.—An article in which he points out that the development of electric roads from actual street railways into interurban systems extending through several States in some instances has naturally led to the building up of a considerable freight and express business as well as passenger service, and this has created an entirely new condition from that which the promoters of these properties originally planned. The present outlook indicates that interurban roads generally will have to interchange traffic among themselves and with the steam railroads; the necessity for adopting a standard traffic agreement and some method of establishing rates for general use between connecting electric roads similar to that in effect among steam roads is urged.—*St. R'y Jour.*, February 7.

Alleged American Conservatism.—An anonymous communication in which the writer claims that because there are more miles of electric track and cars in the United States, American engineers are prone to denounce some of the recent experiments with high-potential railways abroad as impractical. He believes that a greater variety of electrical engineering practice in America would result in a greater advance. The editors do not agree with him.—*St. R'y Jour.*, February 7.

REFERENCES.

Berlin.—The first part of a detailed illustrated description of the electric line construction of the Great Berlin Tramway Company.—*Elek. Anz.*, February 8.

Shaft Straightener.—A description of a device used in the Lake Shore Elevated shops in Chicago for straightening the shaft of the motor when it is bent after taking off the pinion. The shaft is usually bent just inside of the pinion. A sectional drawing of the device, and the appearance of the finished apparatus are shown.

The outer part, which is slipped on to the shaft first, is of such shape as to fit under the overhanging armature of the motor which is used. The second part slips inside of the first. The two are then forced apart by a jack screw. The parts are made of cast steel.—*St. R'y Jour.*, February 7.

Motor Lubrication.—An article stating that the Columbus Company is using oil in place of grease for lubricating motor bearings; a light oil is used in winter and a heavy oil in summer. When the motor is not in use the supply of oil can be shut off by a valve.—*St. R'y Jour.*, February 7.

Railway Signals.—An article discussing the general question of the use of fixed signals on side of the line *vs.* signals carried in locomotives.—Lond. *Elec. Rev.*, February 13.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Polyphase Work in 1903.—EBORALL.—The conclusion of his article the first part of which was abstracted in the Digest last week. Concerning the present practice in power station equipment, he says that the increase in size of the generating plant and the standardization of the revolving field polyphase alternator, are perhaps the most striking features. It is considered as satisfactory that the direct generation of the high-pressure current in the stationary armatures of the alternators is the usual practice in England. With large plants, the limit of the working armature pressure is about 20,000 volts at present, for above this the insulating properties of slot insulations cannot be absolutely depended upon, while it is a difficult matter to insulate the ends of the coils properly, and in any case the machine becomes very costly to build. For pressures above 20,000 volts, step-up oil-cooled transformers must be used in conjunction with the generators, such transformers giving excellent results even with much greater pressure. If the turbo-alternator fulfills the expectations which led to its introduction, certain modifications will be introduced in the design of the revolving field polyphase generator. High engine speed is exceedingly favorable for alternating-current work, especially in conjunction with pure rotary motion. Gas-driven generators can quite well be operated in parallel at low frequencies, such as 25 cycles and thereabouts, and can be successfully built in sizes up to 1,000 kw, yet they are at the present better suited for use in private power stations, such as steel works, etc., than for really large work; no experience is as yet available with regard to the operation of synchronous sub-station machinery from gas-driven alternators. The experience of the next two or three years will show whether the very large steam turbine is a practical possibility; that is, whether its steam consumption, governing, and, above all, general reliability, are equal to the corresponding performance of the best slow-speed steam engines; should this turn out to be the case, it can only be a question of time before the use of the steam turbine will become general, at any rate for alternator driving. The large gas engine and its producing plant have been enormously improved of late. For future large schemes it looks as if it would be a difficult matter for the slow-speed steam engine to hold its own. Concerning the Heyland machines he makes the following remarks: "A type of polyphase generator that will undoubtedly come to the front before long is the asynchronous machines, and the recent invention of Heyland for improving the power factor of induction motors will have led to this. To Heyland must be given the full credit of discovering the means of practically getting rid of the wattless currents of such motors, by producing the rotary flux by means of low-frequency rotor currents drawn from the line through a simple rotor commutator. This again has led up to the self-exciting induction generator, now a commercial possibility, and actually on the market. Such asynchronous induction generators require no exciter, and operate as perfectly in parallel as shunt-wound, direct-current dynamos, to which, indeed, their manner of working is quite analogous. In addition, they have the enormous advantage of having a pressure drop of the order of 3 per cent., irrespective of the power factor of the load; in fact, they can be even over-compounded. This is a very great step in advance, as will be readily seen when it is remembered that a standard revolving field polyphase generator has a drop of 16-18 per cent., even when the power factor of the load is no lower than 0.8." He then gives some notes on high-pressure switchgear. Concerning polyphase transformers, he says that "The increasing use of the core type of transformer, especially for power work, is noteworthy as being a case of the survival of the fittest; the modern three-phase transformers are, of course, always of this type. In the latter connection, it is worthy of note that in America one of the two large concerns has recently started a line of three-phase transformers, following the practice general on the Continent during the last eight years. The three-phase transformer is superior to three single-phase transformers, each having one-third of its output, mainly on account of the great help it gives in balancing the system, and its want was probably not felt in the States, because it is not until very recently that pure three-phase systems for supplying light and power have been put down there." He thinks Heyland's compensating arrangement will come into use for the case of very large motors. In connection with the three-core cable, paper-insulated, he does not recommend the use of an auxiliary copper sheath beneath the armoring, because it is expensive, inconvenient, and not always effective. He thinks the right way of protecting such a cable is by means of a maximum-current oil circuit-breaker at the home end, and a reverse-current circuit-breaker at the far end, which could be arranged without difficulty to cut out the whole cable, should a fault develop in any one core.—Lond. *Elec. Rev.*, February 13.

Manchester.—The first part of a well-illustrated description of the Bloom Street Station of the Manchester Corporation electricity works. This station was erected upon the advent of electric tramways in Manchester required new generating plant for supplying power within the city area. There are four continuous-current generating sets, which constitute the entire generating plant of the station. The engines are vertical compound condensing and run at the slow speed of 75 r.p.m.; each engine gives 3,000 hp. The dynamos are compound-wound for traction, but the shunt winding only is used when working on the lighting load. Each generator has a capacity of 1,800 kw and withstands an overload of 25 per cent. for long periods or 50 per cent. for a short time. They generate direct current at 410 to 440 volts for lighting and 500 volts for traction. The armatures are 12 ft. in diameter, of the drum type, and are lap-wound; the commutators are 10 ft. in diameter, and each machine has 20 poles.—Lond. *Elec.*, February 13.

REFERENCE.

High-Tension Switches.—An illustrated description of various types of high-tension switches and circuit-breakers.—*L'Ind. Elec.*, February 10.

WIRES, WIRING AND CONDUITS.

Wiring for Ship Lighting.—BROADBENT.—The conclusion of his article. He thinks the fact that "double" wiring is often preferred to "single" wiring, is the result of sentiment and an erroneous idea of what "single" wiring really is. Properly carried out, a good single-wire installation, far from being cheap and nasty, is not cheaper than a double-wire one, but is safer, more mechanical and costs less for up-keep. The chief objection urged against the single-wire system, is that it affects the ship's compasses, but this objection is based principally upon imagination, and very few actual instances of compass deviations due to this system of wiring could be cited. All the lamps lighting the compasses, and all others within 20 or 30 ft., should be double-wired. "In fact, single wiring as such is only used in the engine and boiler rooms, where the wires are steel-sheathed, and for the mains to the distributing centers. The whole of the cabin work is practically double-wired on a single-wired installation." The ideal system of wiring for ship work is a complete distribution system in which a separate circuit from a sub-distribution board is run for each individual light; there should be absolutely no soldered joints in any cable or wire. He concludes with some remarks on fittings and accessories.—Lond. *Elec. Rev.*, February 13.

Calculating Networks.—WILBERFORCE.—A short note on a (Brit.) Phys. Soc'y paper on an elementary treatment of conducting networks. He shows that the well-known reciprocal relations between the parts of a conducting network, can be readily established without an appeal to the properties of determinants. The fact that there is no continuous accumulation of electricity at any point gives a series of equations of a certain type, and the application of Ohm's law to every branch of the network gives a second series of another type. These equations are written down for two different sets of external currents and internal e.m.fs and a general equation is obtained from which the ordinary reciprocal relations follow as particular cases.—Lond. *Elec. Rev.*, February 13.

Electro-Physics and Magnetism.

Abnormal Cathode Fall.—Stark.—An account of a theoretical and experimental investigation of the abnormal cathode fall in vacuum tubes. According to the ionic shock theory, the amount of ionization near the cathode depends essentially upon the number of neutral molecules in the unit of volume. This number, called the "specific number of molecules," is of importance in a number of formulas governing vacuum phenomena, and the author proposes to use it for formulating the abnormal cathode fall of the glow current. If that is done, it appears that theoretically the relation between cathode drop and current should not be linear. Since a linear relation has been, however, found by some observers, he made new measurements with platinum electrodes in a vacuum "free from fat." The uniform result is that there is no linear relation between cathode fall and current strength. The fact is that the self-heating of the cathode often stimulates a linear relation. The electric work in the dark cathode space is equal to the product of the cathode fall into the total current. The work spent on the positive ions is converted into heat at the cathode. With a constant pressure, and an increasing temperature, the normal cathode fall remains constant, but the abnormal cathode fall increases while the normal current density at the cathode diminishes.—*Ber. Deut. Phys. Ges.*, November 1; abstracted in Lond. *Elec.*, February 13.

REFERENCES.

Diffraction of Röntgen Rays.—Haga and Wind.—An article in which they reply to a criticism of Walter and offer further evidence of a true diffraction effect of Röntgen rays. The values of the wave length of Röntgen rays deduced from their photographs, differ widely, but are in any case extremely small, and more of the order of the size of a molecule than of the order of the length of light waves.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 13.

Rapid Electric Vibrations.—Seibt.—A well-illustrated paper read before the Berlin Electrotechnical Society, in which he describes experiments well suited for the lecture room, for demonstrating the properties of rapid electric vibrations.—*Elek. Zeit.*, February 5.

Electro-Chemistry and Batteries.

Physical Character of Metal Deposits.—Burgess and Hambuechen.—An article illustrated by many interesting photographs showing the peculiar forms of metallic "vegetation," or growths obtained under different conditions of electrodes. The factors determining the forms of deposits and those which the electroplater has in his power to regulate, are the chemical composition, concentration and temperature of the solution, the current density and circulation; the most important of these is the composition of the solution. Aluminum sulphate added to a zinc sulphate solution affords a marked improvement in the quality of the zinc deposit, although the aluminum sulphate itself undergoes no chemical change. There seem to exist at present few guiding principles showing what substances may be introduced to a metal solution to advantage, and what substances should be avoided. It seems that the viscosity and surface tension of a solution has some relation to the quality of the deposit, and that if a substance is added to a metal salt, which will alter the above properties, the quality of the deposit may be influenced thereby. The authors mention the peculiar fact that the kind of deposit which was obtained from a zinc sulphate solution prepared by dissolving crystals of zinc sulphate in water, was materially different from the deposit obtained under similar conditions of temperature, current density and contents of solution, but in which the solution was prepared by dissolving pure zinc in diluted sulphuric acid until it became of the same neutrality as the solution obtained by dissolving the crystals. The fact, as shown in the preparation of metal alloys, that certain metals have greater affinity for each other than have certain other combinations, seems to make itself evident in the cohesion or attraction between the metal which is electrodeposited and the metal receiving it, and some claim that a good electrolytic deposit requires the formation of an alloy (see the abstract of Kahlenberg's paper in the Digest last week); but the authors think that this alloying phenomenon cannot be held as a universal one. They believe there is a direct cohesion established when solid particles are brought into intimate contact. The deposited metal should be brought into as intimate contact with the surface below as is possible; the adherence of a coating, therefore, depends upon the amount of surface which is brought into contact; a somewhat rough surface receives a more adherent coating than a polished one, because the former is really the larger. The solution should wet the entire surface thoroughly; this property can be imparted to various solutions of metallic salts by the addition of certain other soluble substances, and it is for this reason that such additions are frequently practiced. They finally discuss the causes of the formation of grooves and perforations and of the peeling off of nickel coatings.—*Electrochem. Ind.*, February.

Electrodeposited Metals.—Johnson.—An article in which he discusses from the point of view of the electrolytic dissociation theory, the physical characteristics of electrodeposited metals. He calls attention to the fact that double salts are often used to advantage in electroplating. He believes that these good results are due to two reasons: they require a higher cathode voltage and they furnish the catholyte with a good supply of cations by its continuous decomposition, so that there is always a sufficient supply of cations at the cathode. The term electrode-voltage is discussed at some length. He also gives some notes on the influence of concentration changes in electroplating, and on the reasons why electrodeposited nickel curls up.—*Electrochem. Ind.*, February.

Electroplating.—Haas.—An article on the abuse of electroplating. He describes the very crude methods which electroplaters formerly used in setting up their solutions and performing the plating operation. An electroplater should know exactly what his solution consists of; he should weigh the different materials; he should measure the e.m.f. and the current; he should observe the distance between the electrodes, etc. The size of the anodes depends upon their solubility; gold and silver anodes dissolve rapidly in cyanide solutions, hence only small anodes are required in order to keep the strength of the solution at the proper standard. On the other hand, a nickel anode is only slightly soluble in sulphate of ammonia—which is the regular solution used for nickel plating—hence a large surface of the anode should be used; this is the reason why corrugated nickel anodes are used. He advocates that all plating solutions should be made as simple as possible, to avoid mistakes of the electroplater. —*Electrochem. Ind.*, February.

REFERENCES.

Electrolytic Nickel Refining.—Ulke.—An illustrated article on the history and present development of electrolytic nickel refining. The author gives critical notes on the various processes which have been introduced into practice or have been suggested. The following processes are discussed: Vivian's electrolytic nickel-copper separating works. Balbach nickel refinery; Cleveland nickel and copper refinery (Browne); Hamilton nickel-copper refinery; Papenburg nickel-copper refinery (Hoepfner); proposed Sault Ste. Marie copper and nickel refinery.—*Electrochem. Ind.*, February.

Storage Battery for a Laboratory.—Humphreys.—An article illustrated by a diagram, on a convenient storage battery installation for a physical laboratory.—*Phys. Rev.*, February.

Biographical.—The continuation of the serial on pioneers of electrochemistry contains a biographical sketch, with portrait, of Wilhelm Ostwald.—*Electrochem. Ind.*, February.

Units, Measurements and Instruments.

Magnetometer Free from Magnetic Disturbance.—Kohlrausch and Holborn.—A description of a suspension for a magnetometer, which is intended to obviate disturbance by electrical railways and similar causes. This is accomplished by means of an astatic combination, in which two magnets, 6 cm long and 7 mm thick, are connected by means of a brass rod about 1 meter long, and suspended by a platinum-iridium torsion wire. Thus the earth's field and its disturbances are completely eliminated, and the authors show that it is quite possible to carry out magnetometric measurements with the lower needle alone up to distances of 1 meter when the vertical distance between the rods is not less than 127 cm. But this is only possible in the "first chief positions" of Gauss, while in the "second chief position" the influence of the deflecting magnet upon the upper needle is very marked. In the first or "end-on" position, the lines of force of the deflecting magnet pass through the upper needle in a slanting direction, and it is easy to arrange meters so that the horizontal force upon it is negligible.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 13.

Quadrant Electrometer.—Walker.—An abstract of a (Brit.) Phys. Soc'y paper on the theory of the symmetrical quadrant electrometer. Hopkinson has pointed out the imperfection of the usual formula given by Maxwell, and has given an empirical formula

which closely represented his experiments. The general result is that the sensibility of the electrometer rises to a maximum as the potential of the needle is raised, and that any further increase in the potential of the needle reduces the sensibility. The author's experiments have been made with a sensitive electrometer which shows a maximum sensibility when the potential of the needle is about 100 volts. The sensibility seems to go on diminishing after this, at least until very high voltages are used. The formula for a quadrant electrometer is rigidly investigated and an equation is arrived at which is practically identical with the empirical formula of Hopkinson and which represents exactly the results obtained in the author's measurements. The equation contains a constant which must be positive to explain the results, and it is shown that this is the case. An investigation is then undertaken to obtain a numerical value for this constant. The solution of the electrical distribution for a system like the quadrant electrometer is very difficult, but he discusses and solves a similar two-dimensional problem which confirms his view that the air-gap is sufficient to account for a maximum sensibility depending upon the potential of the needle. The ordinary formula would be more nearly obeyed with a small air-gap. It is pointed out that, although diminishing the air-gap raises the potential of maximum sensibility, it does not follow that higher sensibility is obtained by reducing the air-gap. He then discusses the results obtained by Ayrton and Sumpner with a White electrometer having a bipolar suspension in which the variation in sensibility is shown to be due to want of symmetry.—Lond. *Elec., Elec. Rev.,* February 13.

Large Inductance Coils.—IVES.—A theoretical article on the best dimensions for large inductance coils. He arrives at the following conclusions: A coil of maximum inductance must have a square cross-section. The inductance of a coil, with a given length of wire, increases rapidly, as the mean radius is increased, up to the maximum inductance, and then, as the mean radius is increased still further, decreases very slowly; therefore, it is better to make the mean radius too great than too small. For coils of maximum inductance, the inductance increases very rapidly as the length of wire used increases; not quite as fast as the square of the length.—*Phys. Rev.,* February.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Earth Current Disturbances and Telephones.—TAYLOR.—An abstract of a Royal Soc'y paper dealing with the disturbing effects produced by rapidly varying earth currents on a telephone receiver connected in a short line of telegraph having both ends earthed in the sea. The sounds produced have certain well-marked characteristics. In these latitudes they are stronger and of more frequent occurrence in summer than in winter; they are daily in evidence for a few hours at, or about, the time of sunset, while daylight is fading; they are readily precipitated by a state of electrical tension in the atmosphere which may culminate in a thunderstorm. Several characteristic forms of disturbances are described. It is suggested that the changes of ionization of the atmosphere offer a reasonable explanation of the greater night-time efficiency in signalling observed by Marconi with Hertzian wave telegraphy.—Lond. *Elec. Rev.,* February 13.

MISCELLANEOUS.

The Genesis of Lightning.—WALTER.—An account of an experimental investigation of the way in which lightning originates. He proved some time ago that an electric spark originates chiefly at the positive pole and is preceded by a number of preliminary sparks of increasing length, following each other at very short intervals and feeling their way towards the negative pole. Some very successful photographs of lightning flashes taken with a moving camera have since enabled him to demonstrate that the genesis of lightning is accomplished by a precisely similar process. Every flash is preceded by a number of minor flashes, branching out towards the earth. The path remains the same in all its ramifications during the succeeding flashes, though the various branches are not always equally illuminated, and further branches are added. A path once made through the air becomes conducting and is then utilized for further discharges. One of the pictures is that of a flash consisting of three main flashes with time intervals of 0.0177 and 0.0489 seconds respectively. Another discharge consisted of five equal flashes lasting altogether a quarter of a second. One photograph shows evidence of an alternating discharge, but as a rule it may be taken for granted that the lightning process is a series of continuous discharges, and proceeds practically from the cloud to the earth.—*Ann. d. Phys.,* No. 2; abstracted in Lond. *Elec.,* February 13.

Manufacturing Plant.—A well-illustrated description of the Wilton Works of the (English) General Electric Company, Ltd., which have been in operation for about 6 months, as the main plant at Manchester could not fill all the orders. The new plant is devoted chiefly to the manufacture of dynamos and motors, but comprises in addition a small factory for interior conduits and one for carbons. The demand at present for direct-current motors being greatly in excess of that for polyphase, it was decided to adopt direct instead of three-phase current for power distribution in the plant itself, and to put down a power station equipped somewhat on the lines of a public supply station. Therefore, the generators give 460 volts on a three-wire network, the smaller amount of three-phase testing being provided for by a motor-generator.—Lond. *Elec.,* February 13.

New Books.

GALVANIC BATTERIES, THEIR THEORY, CONSTRUCTION AND USE. Comprising Primary, Single and Double-Fluid Cells, Secondary and Gas Batteries. By S. R. Bottone. London: Whittaker & Co. 376 pages, 144 illustrations. Price, 5 shillings.

The plan of the book is in general that of the ordinary works on this subject. The first chapter opens with a short historic sketch of the galvanic cell, then goes on to describe the simplest form of cell, gradually building up the more complicated forms in the subsequent chapters. There is a pretty thorough account of the different cells in use, besides some proposed and some obsolete ones. The theories and explanations of the reactions are the ones that have been doing duty for years; some are adequate and some are not.

An example of the latter class is the "nascent hydrogen" hypothesis. On page 143 we read, "As soon as the nitric acid begins to be decomposed by the nascent hydrogen, so soon are the irritant and noxious fumes of nitrogen trioxide given off." If no nitric acid, or other "depolarizer," be present, hydrogen is set free at the cathode. If nitric acid be present, hydrogen is not set free, but nitrogen trioxide is. These are the facts, but the nascent hydrogen hypothesis adds the purely gratuitous assumption that hydrogen is first set free in the nascent state, and then by virtue of the peculiar chemical activity of the nascent state, it recombines with part of the oxygen of the nitric acid. In other words, water is decomposed into oxygen and hydrogen by virture of the e. m. f. of the cell, but having once been set free the hydrogen becomes so energetic that it immediately recombines with some other oxygen in spite of the e.m.f. Is it not more rational to assume that when nitric acid is absent, water is decomposed into oxygen and hydrogen, but when nitric acid is present water is not decomposed but nitric acid is? The nascent hydrogen hypothesis asserts that copper is reduced on the cathode of a gravity cell by the nascent hydrogen. The more sane theory is that when the cathode is surrounded by sulphuric acid, that is hydrogen sulphate, hydrogen is deposited on the cathode. When the cathode is surrounded by copper sulphate, copper is deposited; when by silver sulphate silver is deposited; when by ferrous sulphate, iron is deposited.

The criticism of this and other old theories or hypotheses, of course, applies to most other works of the class of the one before us, so we do not wish to be unduly severe, yet we think it not out of place to suggest that in writing a new book on batteries it would be a good idea to exercise some editorial discrimination in quoting current theories, retaining only those that have withstood the test of criticism. Furthermore, laying aside theoretical considerations, we have a word to say regarding additional facts. It is a fact, long ago established by Dr. Wolcott Gibbs, that if the nitric acid be saturated with ammonium nitrate, the noxious fumes are entirely suppressed; the only gas liberated being nitrous oxide, an entirely innocuous substance. We find no mention of this fact in the remarks before cited, in which the advantages and disadvantages of nitric acid and nitrates are discussed.

On the whole, the book is a good one, containing a considerable amount of reliable information.

ELEMENTARE VORLESUNGEN UBER TELEGRAPHIE UND TELEPHONIE. By Richard Heilbrun. Berlin: Georg Siemens. 64 pages, 44 illustrations. Price, 1.60 marks.

This is a charmingly written little elementary treatise in the German language, written for the technical instruction of practical telegraphers and telephonists. It is divided into four chapters, as follows: I. On the Electric Current and its properties, with Ohm's law. II. Electrical Units. Also electric heating, Joule's law. III. Magnetism, magnetic fields and elementary magnetic laws. IV. Electromagnetism and the elementary principles of the magnetic circuit.

The illustrations are simple and the description in the text is clear. A few simple equations are employed to symbolize the laws enunciated. There is very little said about either telegraphy or telephony in the pamphlet; but everything that is described and stated bears upon the essential principles of those industries.

ISOLIERMATERIALIEN UND WARME (KALTE) SCHUTZMASSEN. By Eduard Feltone. Leipzig: A. Hartleben. 320 pages, 38 illustrations. Price, 5 marks 30 pf.

This is a treatise on the manufacture and use of material for heat non-conductors, irrespective of whether such appliances are used to keep hot bodies warm, such as steam boilers, steam pipes, etc., or whether they are used to keep cold bodies cool, as in refrigerators, safes, etc. The 150 first pages are devoted to a description of the various artificial compounds used for this purpose, particularly the various magnesia and asbestos preparations, together with the chemical reactions that accompany the processes of manufacture. Next the various methods and kinds of machinery employed to convert raw material into convenient and desirable form for practical application are described. The latter part of the volume deals with some of the methods involving the employment of heat-resisting materials. This latter portion of the book seems quite at variance with the prevailing American customs, which, in many respects, appear to be somewhat in advance of the methods abroad.

ELECTRICAL DICTIONARY: ENGLISH, GERMAN, FRENCH. By Paul Blaschke. Leipzig: S. Hirzel. 226 pages. Price, 5 marks.

The German appellation "Wörterbuch," or "word book," describes this volume much better than the English term "Dictionary." It is in truth a sort of phrase book, in which electrical terms in the three languages—English, French and German—are correlated, so that one may readily obtain the expression in either language for an electrical idea. In this respect it is rather more than a dictionary, but there is no attempt at definitions. The typographical plan is excellent. The phrases in three languages are arranged alphabetically in large type, while their correlative expressions are printed in smaller type. One may, therefore, look alphabetically in either English, French or German, finding opposite the same the corresponding equivalents in the other two languages. The book in its plan follows closely the excellent word book of Prof. Hospitalier, which appeared about three years ago.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE, Secretary, Wm. J. Davis, Ithaca, N. Y.

ENGINE BUILDERS' ASSOCIATION, F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky.

IOWA TELEPHONE ASSOCIATION, Secretary, C. C. Deering, Des Moines, Iowa. Next meeting, Des Moines, March 10 and 11, 1903.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION, Secretary, H. K. Cole, of Lancaster, Ky.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

SOUTHERN INDIANA TELEPHONE ASSOCIATION, Secretary, E. W. Pichardt, Huntingburg, Ind.

British Westinghouse Works.

We illustrate herewith the new works of the British Westinghouse Company, which are situated at Trafford Park, a suburb of Manchester, England. Those who have visited the Pittsburg Westinghouse works will see the resemblance between the two great manufacturing establishments. The British works have an advantage over the American establishment in its situation with respect to water shipping facilities, being bounded on two sides by the Bridgewater Canal and but a few hundred feet distant from the Manchester Ship Canal. One feature of interest is the location in the immediate vicinity of the works of a town of 500 houses built for the workmen.

Fig. 2 gives an idea of the interior of the main aisles of the machine shop, and Fig. 3 is a plan of the works. In the erection of the works 17,000 tons of steel, 9,000,000 ft. of timber and 300,000 sq. ft. of glass were used, and 3,000 workmen employed. About 12 months elapsed between the laying of the corner-stone and the opening of the works. The total area occupied is 130 acres, and there are no less than 20 miles of standard railroad track laid within this area.

The office building, which is 6 stories high, has 75,000 sq. ft. of floor space. The entrance halls are empanelled and staircases paved entirely with white marble. All furniture and woodwork is of polished oak, and each office is provided with a small lavatory and wardrobe. Records, drawings and similar valuable property are stored at one end of the building, which has been rendered entirely fireproof, and divided into strong rooms. On the various floors are the rooms of the heads of departments, draughtsmen, accountants, shipping and general clerical staff. On one of the upper floors is a dining-room furnished in mahogany, which is for the use of those occupying the more important positions in the works, and adjacent to it is a kitchen replete with every modern appliance. Confusion is reduced to a minimum. On the extreme east is situated the iron foundry, 600 ft. in length by 180 ft. in width, containing at present two cupolas, one having a capacity of about 18 tons. Outside this foundry, and at the east side, is built a store, entirely of iron, which has a plate floor on a level with the charging platform. Underneath the store is a railway track, and by means of a hydraulic lift the pig or scrap iron can be conveyed directly from the railway wagon to the charging platform. Running down the center bay are two electrically-operated overhead cranes, each capable of raising and carrying a load of 50 tons. Each is also provided with a lifting gear for weights not exceeding 10 tons, and the respective motions are controlled by three separate motors. There are also in this foundry the usual sandmills, sieves, grinding and scouring machines, all driven electrically. Lighting is carried out by means of Bremer arc lamps placed on brackets from the main steel pillars, and a standard gauge track runs from one end of the building to the other.

In the next building to the west all the brass and malleable iron casting is carried on. The northern end, about 170 ft. in length and 75 ft. in width, is occupied by the brass foundry, where parts of

arc lamps, instruments, terminals, brush-holders, etc., are cast. Another part of this building consists of a store for all kinds of brass work, and is isolated from the foundry by means of a brick wall with fire-proof doors. Both portions of this building are provided with galleries, and that above the stores is used to accommodate the printing and bookbinding department. There is also a chemical research laboratory railed off with expanded metal.

FIG. 1.—GENERAL VIEW OF THE WORKS, TRAFFORD PARK.

The third block from the left contains, under one roof, the steel forge and foundry. Running down the center of the building there is, however, a brick wall 12 ft. high with an 18-ft. break in the middle to allow of railway and crane communication. Two 20-ton Wellman patent tilting open-hearth furnaces have been installed, and are operated by five Duff gas-producers. By means of electric power metal is conveyed up an inclined approach from the railway to the charging platform. Electric motors also provide the necessary rolling motion of the furnaces, and owing to the reduction in the gearing no difficulty in control is encountered when dealing with large masses of molten metal. This steel foundry is also provided with two 50-ton overhead traveling cranes, and there are in addition, a large number of smith's hearths, etc.

The carpenters' and pattern shops are distributed over three floors and accommodate about 250 men. The most modern tools for use in connection with wood-working have been installed and are electrically driven from countershafting in the case of small machines which are frequently used, while the larger ones are separately driven.

The largest and most interesting building of the whole works is the machine shop. The total length is 1,000 ft. and the width 450 ft., thus bringing the superficial area up to approximately 10 acres. There are five bays which run throughout the entire length of the building and are lettered A, B, C, D and E. Two of these extend from floor to roof, while the others are two stories high with an intermediate or mezzanine floor on which are provided lavatories, etc., for the convenience of the workpeople employed in this particular shop. The preparation of insulating material, the winding of small coils and other lighter work is performed by girls in the

FIG. 2.—VIEW OF MAIN AISLE OF MACHINE SHOP.

upper galleries, where the machining and working necessary for component parts of instruments, arc lamps, etc., is also carried on. Although so far from the floor these galleries are by no means close or stuffy, the ventilating arrangements being so complete as to prevent such a condition. In aisle A on the ground floor are the punching machines for armature stampings, etc., and the guillotines which shear off sheet metal of considerable thickness. These are not to be numbered by twos or threes, but by whole rows containing dozens. In the other bays are numerous machines, several of which may be attended to by one man. They are entirely automatic in their action, so that it is merely necessary to fix the rod of metal in the chuck, make the adjustments to the various tools and start the machine, when it will, without any further attention, continue to turn out finished articles until the metal runs out, when it stops automatically. In this way an enormous amount of labor is saved, and at the same time the possible output is considerably increased. Comparatively small work, such as the construction of traction motors, is carried on in the side aisles. Each section of the shop has a separate store and timekeeper's office, to which are affixed the automatic clocks for checking the arrival and departure of each man.

The floor of the shop has a foundation of solid concrete 12 in. thick, over which asphalt bricks are laid, thus rendering it quite impervious to oil and fire. The roof is constructed almost entirely of glass, and the illumination of the shop, whether during the day or at night, is rendered all that is desirable by the pale green shade of the paint which has been used. The heaviest work is carried on

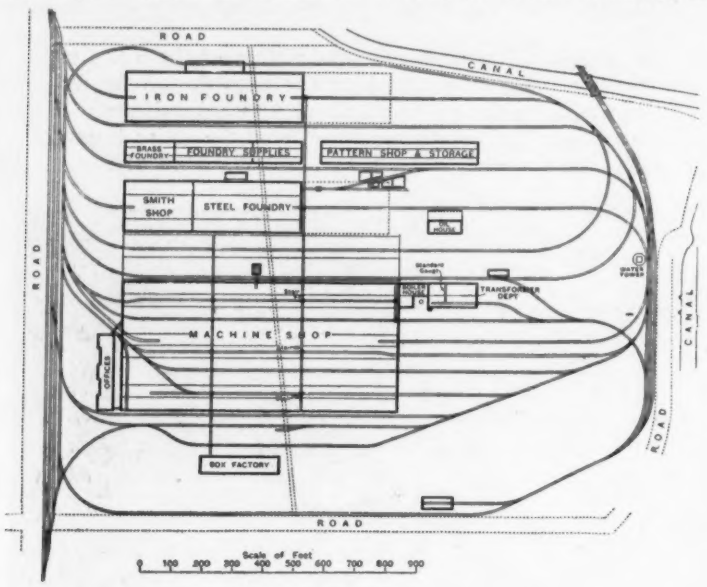


FIG. 3.—PLAN OF WORKS.

in the two main aisles, which contain some very interesting and modern tools of an exceptionally large size. Individual driving by motors is mostly resorted to here, but where it is not, motors are belted to shafting. Space has been economized as much as possible by fixing motors to the ceiling, to girders, or, in fact, to almost anything so long as they are not on the floor. The galleries are well and substantially constructed without joists. The floors consist of boards 2 in. by 10 in., placed edgewise, side by side, and spiked together. A light flooring is then laid on this and the whole supported by steel girders.

When it is inconvenient to move large work frequently from one tool to another, the plan of bringing portable tools to the work has been adopted. Motors are fixed to these tools, and the whole equipment, weighing many tons in some cases, is lifted bodily by a crane and deposited on the exact spot at which it is to be used. Overhead cranes, with a span of 90 ft., run the whole length of the shop; each is capable of lifting 50 tons, and is operated and controlled electrically by a man situated in a suspended cage. Similar cranes of varying capacity are installed in the other bays of the same shop, on both the ground floor and galleries, and every appliance is there for the conveyance of work, etc., other than by hand. Down the center of the building runs a standard gauge railway track, which allows of work being brought almost straight to the machine, where it can be lifted off and deposited in the required position by the overhead cranes. The works has its own steam locomotives for use on the sidings and within the works area.

An interesting feature of the organization of the works is the very perfect system of fire alarms which has been adopted. Fixed to walls at frequent intervals are small iron boxes with glass covers, under each of which is a switch handle. These boxes are numbered, and when the switch lever is pulled over a large bell, situated near the switchboard controlling the whole of the works, is rung. A practical demonstration was given on box No. 15, and the bell immediately struck once and, after a short interval, five times in succession. This, however, was not the only indication: a small indicator, numbered 15, fell and a tape machine printed a single dash and five successive dashes on a tape. The attendant, on observing this, immediately pulls the whistle string for the correct number of times, and every employee is made at once aware that a fire is in progress and of its locality.

The power station, from which energy is derived for the lighting and driving of the entire works, is situated at the south end of aisle B in the machine shop. There are four double-drum Babcock and Wilcox boilers fitted with Roney mechanical stokers, and each has a heating surface of 4,020 sq. ft. Steam is delivered to two 750-kw, three-phase alternators, directly coupled to Westinghouse vertical steam engines. The alternators generate current at 440 volts and at a frequency of 25 periods per second. There are also two 250-kw three-phase generators and two 62½-kw exciters, all directly-coupled to steam engines. Throughout the works three-phase motors are used for driving, with the exception of the testing departments, where it is, of course, necessary to have continuous current. This is obtained from 500-kw rotary converters situated near the main generators.

All the buildings are connected by tunnels, constructed of concrete, which carry the pipes and wires used for various purposes. After a period of about two years it is intended to replace the steam generating plant by gas engines, when it is expected that the capacity will have to be considerably augmented. The existing boilers will then be used entirely for heating purposes.

Outside the works, at the south end, is a water tower 210 ft. high, on the top of which have been placed two tanks, each having a capacity of 30,000 gallons. These tanks are connected with a network of pipes which run all over the buildings, and in the event of a fire occurring the Grenell sprinklers fixed to the pipes immediately and automatically commence to quench the outbreak by means of water from the tower. It will thus be seen that extreme precautions have been taken against the destruction of the works by fire.

The company has introduced a feature new in Great Britain in receiving apprentices in its shops without premiums, and, moreover, paying them wages from the commencement of their time. Each candidate is examined as to his technical and general knowledge and is drafted into either the "college" or "school" course, according to ability. The former extends over three years, and embraces rather more advanced work than the latter, which covers four years. Apprentices are permitted to enter nearly all the different departments during the three or four years, as the case may be.

Hydro-Electric Power Development in Italy.

The Maschinenfabrik Oerlikon of Oerlikon near Zurich has recently received a contract which covers the development of the water power of the Caffaro River and its transformation into electrical energy. The river has its rise on the Alps, which form the frontier between Italy and Tyrol, and discharges its waters into the Chiesa River.

The complete installation is calculated for a total output of 15,000 hp., measured at the turbine shafts, and comprises two separate power stations. The up-stream station, which will be built later on, will supply 5,000 hp, whilst the hydro-electric power station, about to be erected and situated within the Italian township of Bageline, will make some 10,000 hp available. In both central stations three-phase currents of 9,000 volts, 42 cycles, taken from the generator terminals, will be transformed up to 40,000 volts.

The current at this pressure will be transmitted to Brescia, some 16 miles distant, where it will be partly used for power and light distribution in the Province of Brescia, and partly for operating large electrochemical works.

The down-stream station, which is now in course of construc-

tion, commands a water power with a head of 254 meters, which corresponds to an effective turbine output of 10,160 hp. The upper-water channel has a length of 4,500 meters and passes three tunnels, one of which is 2,300 meters long.

In the down-stream central station five hydro-electric groups of a capacity of 2,500 hp each, will be installed. Each group consists of a turbine directly coupled to a three-phase generator making 315 revolutions per minute. Besides these large groups there will also be two smaller turbines of 160 hp output each and with a speed of 600 revolutions per minute. They are coupled each to an exciter generator. One exciter suffices for four three phase generators, so that the other exciter and the fifth hydro-electric group will serve as a reserve.

The three-phase generators are calculated for absorbing 2,500 hp with a power factor of .75 and will have an output of 2,340 kw. The three-phase currents generated by them have, as stated above, a voltage of 9,000 and a frequency of 42 cycles.

Five step-up transformers, each of 2,340 kw., will bring the pressure of the current up to 40,000 volts, which, after transmission, is by an equal number of step-down transformers lowered to the working pressure.

This installation is of special interest, as being the first plant in Europe making use of 40,000 volts with transformers of a capacity exceeding 2,000 kw.

Italian Recording Wattmeters.

The Italian Valtellina electric railway has in operation two large recording wattmeters for its three-phase circuits, manufactured by Camillo Olivetti, of Ivrea, Italy, a description of which we give below:

The principle on which the instrument is based for its action is the same as that which controls the working of a torsion electro-

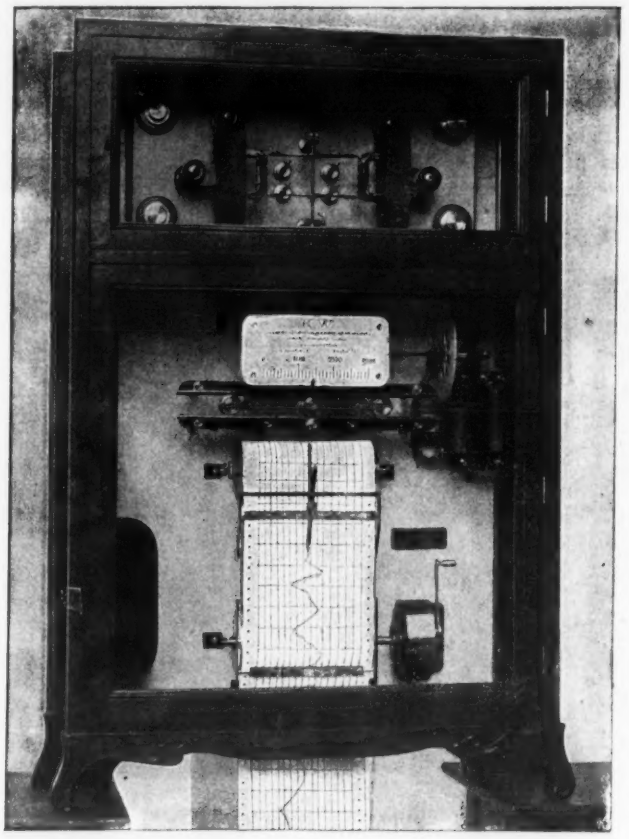


FIG. 1.—COMBINED INDICATING AND RECORDING WATTMETER.

dynamometer, viz., that in a magnetic field produced by a current traversing a fixed low resistance coil connected in a series with the main circuit to be measured, there is placed and allowed to move a high resistance coil connected across the main. When the instrument is completely connected the moving coil will be urged by a force which is proportionate to the energy of current. This effort is counterbalanced by the torsion of a spring which has a tendency to move the coil equipment towards zero position, the spring being forced at one end by the action of a small electric motor which is at rest so long as the torsion effort of the spring is balanced by the action of the current. As soon, however, as this state of equilibrium is disturbed and the action of the current on the equipment is superior or inferior to the torsion effect of the spring this brings to zero point the moving equipment.

As it will be understood the principle is general and can be applied to any instrument having a movable equipment returning automatically to zero point.

Referring to Fig. 3, which gives a schematic representation of the apparatus and to Fig. 4, which gives a diagram of connections,

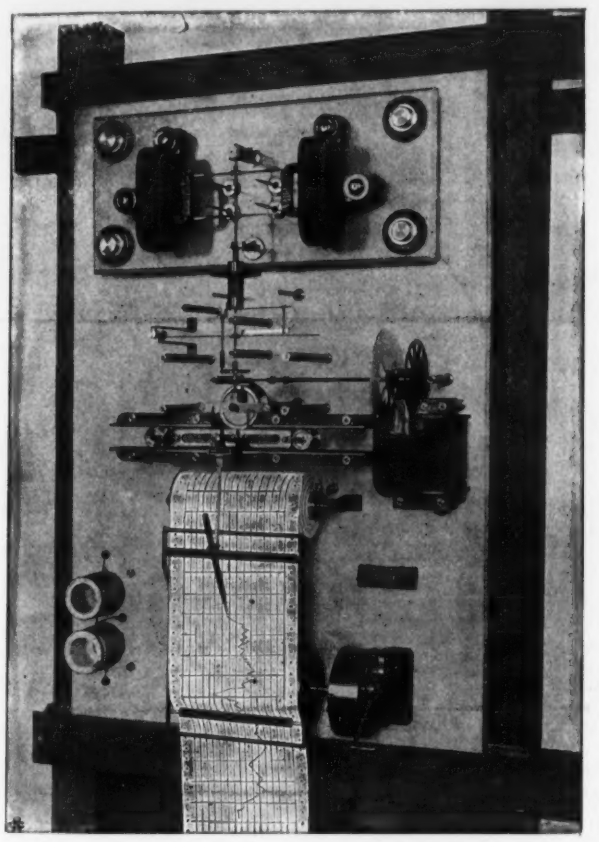


FIG. 2.—WATTMETER WITH CASE REMOVED.

it will be seen that the high-resistance coils, 1, 2, of identical construction, are connected across the mains by means of two flexible connections, 6, 7, through two additional non-inductive high resistances, 10, 11, with a temperature co-efficient practically nil.

The two coils are of wire insulated, but mechanically and rigidly held together by a frame, 3, this latter being supported by a vertical spindle, 4. The spindle and the coils are capable of deflecting within a small space, and the former is pivoted on two supports, 5, 51. The high-resistance coils are for half the length within the two coils, 8, 9, connected in series with the line and as shown on diagram Fig. 4.

The spindle, and with it the equipment, as described above, can be made to deflect by means of a spring, 13, connected at one of its extremities by means of a rigid pin, 14, and the other extremity to a small shaft, 15. The axis of this is on the same axial line of the shaft, 4, and carries a small tooth wheel which can be made to rotate by means of a worm wheel, 17, driven by a small electric motor, 18. A third shaft, 19, co-axial with the former ones and connected to the spindle, 4, by a spring, 20, and the small arm, 21, carries a rigid pin, 22, fitted with a thin silver ribbon. This ribbon can oscillate between two fixed points, 23, 24, which are also of silver, and is so placed that an electric contact can be made between the pin, 22, and either of the other two points, 23, 24. The worm wheel, 17, is connected to a second tooth wheel, 25, which, by means of another wheel, 26, operates a rack, 27, as shown on Fig. 3. This rack carries a pointer, 28, which gives readings on a divided scale, 29. To the pointer structure is fixed a pen, 30, which records the readings on a divided strip of paper revolving on a drum, 31, which is operated by a clock-work system, 32. In non-recording indicating wattmeters the wheel, 26, the rack, 27, the

drum, 31, and the clock-work, 32, are eliminated, and the pointer is fixed right to the wheel, 25, the range of rotation of which is within 300°.

By means of a flexible conductor, 33 (Fig. 4), the spindle, 22, is electrically connected to one brush, 18_8, of the small motor, while the other brush, 18_6, is connected by means of the conductor, 34, to an intermediate point of connection of the two resistances, 35,

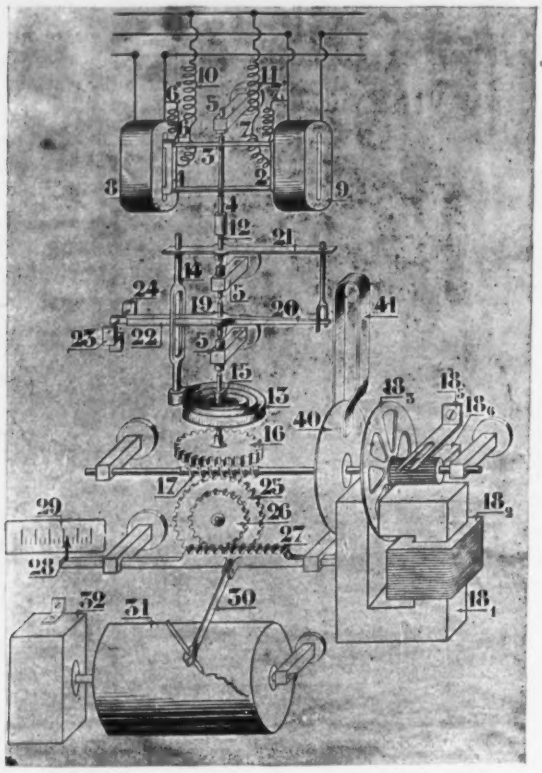


FIG. 3.—SCHEMATIC REPRESENTATION OF WATTMETER.

36, which are connected in series with the series field winding of the motor and in a parallel with the line (if necessary through a small transformer, 39). The contact point, 23, is connected by means of a conductor, 37, with one end of the resistance, 35, and the point, 24, by means of a conductor, 38, with the other extremity of the resistance, 36. The two resistances, 35, 36, are connected in such a manner that at their extreme connections the current has a different polarity in respect to the point of union, and accordingly, if the spindle, 22, comes in contact with the point, 23 or 24, the direction of the current in the armature is in one or in the opposite direction. The motor is so constructed that by reversing the current in the armature the rotation of the latter is reversed, and therefore by means of a screw wheel, 17, and a gear wheel, 16, the spring, 13, becomes tightened or loosened according to the direction of rotation of the motor. When the spindle, 22, is in an intermediate position, no current passes through the armature and the motor is thus at rest.

For the sake of illustration suppose that the instrument is connected to a live circuit. Between the windings, 1-8 and 2-9, electrodynamic actions take place, and in one direction, so as to deflect the moving frame with a torque proportionate to the total energy of the three-phase circuit. This deflection, which covers a very small angle, is transmitted by means of the shaft, 4, and of the spindle, 21, to the spindle, 22, which comes then into contact with one or other of the contact pins, 23 and 24. For the sake of further illustrating the action of the instrument, suppose that the spring, 20, makes contact with the pin, 23. As soon as this takes place the motor starts and by means of the screw wheel, 17, the motion is transmitted to the gear wheel, 16, and consequently to the extremity of the spring, 13. The equipment, 16, will have then rotated within a limit proportionate to the energy of the circuit and also the rack, 27, will have moved on for a distance proportionate to this energy. If the electro-dynamic action between the coils is reduced, the motor will reverse so as to again equilibrate the new value of such actions. Through the co-efficient of elasticity of the spring being constant, the divisions on the scale will be absolutely uniform.

A Faraday disc, 40, makes the instrument aperiodic in its action and also regulates the speed of the motor. By multiplying the number of the shunt moving coils and the series fixed coils, the instrument can be made to measure the power of two or more alternating or continuous-current circuits. The same apparatus described with suitable connections, might also be used to measure the power of a polyphase alternating-current system or direct-current system of supply and with other suitable connections give the aggregate power of two separate circuits.

It is claimed that in this instrument all the theoretical and practical conditions of a precision instrument are practically observed. Friction being nullified by the positive and instantaneous action of an especially designed motor has practically no influence. The measuring part of the instrument contains no iron. The inductance and temperature co-efficient of the shunt coils are rendered practically nil by very high series resistances, so that the instrument is independent of the nature or frequency of the current form and temperature. The same instrument can be used for direct as well as for alternating circuits.

The energy wasted in the series coils is from 16 to 20 watts, and in the shunt coils and resistances from 2 to 4 watts for every 100 volts, the former figure being for high-potential, the latter for low-potential instruments. The energy wasted in the relay motor is from 30 to 50 watts. The small current in the shunt coils, .02 ampere, permits the insertion of the instrument direct in high-potential circuits without the intermediate use of potential and current transformers, which have a tendency to impair the exactness of readings. The scale is perfectly uniform, and in recording instruments has a length of 6 inches.

The paper used in the instrument has a length of 120 ft. and a width of 7½ in., of the latter, 6 being for recording purposes. The speed of paper can be changed from 1 to 12 inches per hour, and the change of speed can be readily obtained, changing a gear on the clock.

On the same principle and about on the same dimensions, Signor Olivetti makes also a continuous-current recording ammeter and voltmeter similar to the wattmeter above described. In these instruments the fixed coils are replaced by permanent magnets. The moving coils swing on the air-gap of the same and are connected to shunts or series resistances, according the instrument is an ammeter or voltmeter. On the same princjple, he constructs an electrodynamic voltmeter having two fixed and one movable coil connected in series to a inductionless resistance. The scale follows

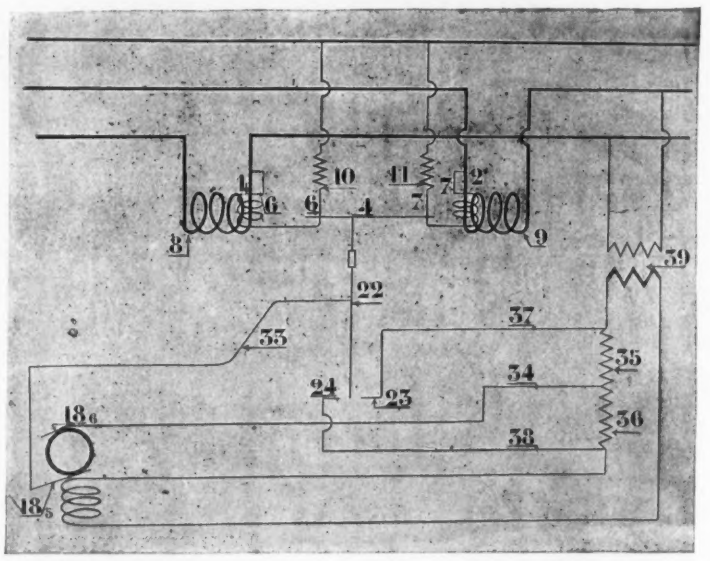


FIG. 4.—DIAGRAM OF CONNECTIONS FOR WATTMETER ON THREE-PHASE CIRCUITS.

the law of the squares. The instrument can be made direct-reading or recording. These instruments, if made for high-potential, require a current of 0.05 amp.

One of these direct-reading voltmeters having a large round scale of 15 inches diameter and 300° amplitude, provided with a set of resistances for reading from 1,000 to 20,000 volts, is used in Signor Olivetti's laboratory for standardizing direct-reading voltmeters.

The Henry Train Lighting System on the Chicago and Alton R. R.

As early as 1893, the late John C. Henry, one of the pioneers of the electric railway, took out a patent on an electric regulator. After working for ten years upon the subject of train lighting by electricity, in 1901 Mr. Henry settled on a direct-connected system of train lighting, doing away with all belts, gears or other devices used to drive the generator from power derived from the axle. This system of train lighting has been further developed by his son, D. Carl Henry. As now used on the Chicago & Alton Railroad, it consists of the following devices: On the axle of the train or car to be lighted a direct-connected generator is placed, Fig. 1. The armature of this generator is built on a sleeve, the sleeve being centered over the axle, and is held in place by two taper copper plugs, which are held in place by two long bolts, which bind the sleeve permanently to the axle. After this generator is mounted, the wheels of the car are pressed on the axle. The outer fields of the generator have bearing on this sleeve and are supported by it. These outer fields remain stationary, being prevented from turning and following the internal armature by a crossbar, resting on the truck of the car. This inner armature and commutator revolves within these outer fields, cutting the magnetic lines. The entire machine is absolutely dust and water proof. After thirteen months' experimenting on the Chicago & Alton Railroad, a generator was determined on which gave, at a speed of 200 r.p.m. a minimum output of two kw. This is a 4-pole shunt-wound machine, built and insulated very much in the style of the

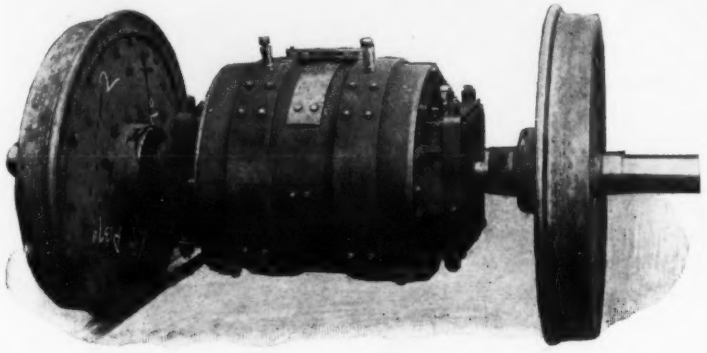


FIG. 1.—DIRECT-CONNECTED GENERATOR.

series street railway motors of the present day, and is capable of 100 per cent. overload without too high an increase in temperature and consequent loss in efficiency. The problem of vibration is met with the novel means employed to mount this generator on the axle. After thirteen months of hard service, these generators have been found to be in absolutely first class condition, and even their commutators have shown no effect from hard usage. The machine is easy of access and is constructed so that the armature can be inspected and re-wound, if necessary, at any time. It is but a few minutes' work to place new brushes in their holders. The oiling of the machine is done by means of a chain dipping down into an oil well; and the brasses of each bearing can be replaced in a few minutes. The weight of the generator is less than 900 pounds.

The regulation is effected by means of a differentially-wound field, the major portion of this field being in shunt, and a minor winding of low resistance being in the opposite direction. The shunt field is separately excited by the storage battery. This insures, it is said, perfect excitation on starting and reliability at all times in operation. At a speed of 200 revolutions the current from the generator, which is at a voltage of 25, passes directly to one of two sets of storage batteries. Below this critical speed of 200 revolutions, which represents about 18 miles an hour, an automatic switch, Fig. 2, operated by a solenoid cuts the generator circuit in such a manner that the storage battery current cannot flow back to the generator. This switch only allows current to flow from the generator to the battery. While the generator is charging one of the two sets of batteries the other similar set of batteries is on the lamp or translating circuit. A simple hand switch is placed in the circuit and by a single quarter turn the battery which is being charged by the generator can be substituted for the battery which has been discharged. This insures at all times a constant potential, the lamps being at no time directly on the generator circuit. The batteries employed are the "Chloride" accumulator type; 24 cells of battery are used, with a capacity exceeding 30 amperes for eight hours. As these batteries are always in multiple, Fig. 3, the system has a capacity in each car of 60 amperes for eight hours, which is amply sufficient for an ordinary car. These batteries are placed in lead-lined tanks, two cells of battery in each tank.

The Henry Electric Equipment Company of Denver, Colo., of which Mr. C. F. Elliott, of Colorado, is president; Mr. D. Carl Henry, of Chicago, is secretary, and Mr. James H. Peabody, of Denver, Colo., is treasurer, has now under construction fifty of this type of generator, to be used on the Chicago & Alton Railroad. Experiments have been

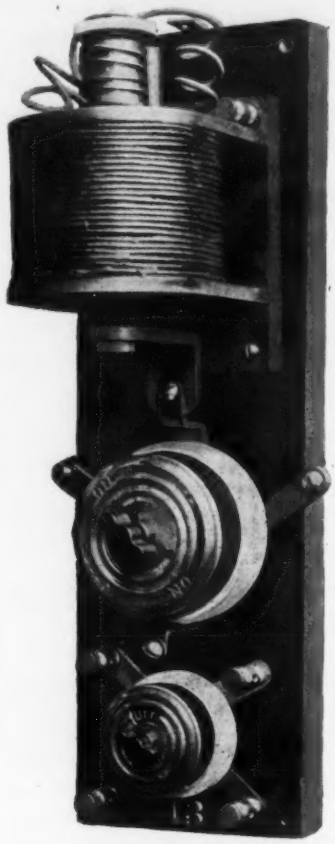


FIG. 2.—AUTOMATIC SWITCH.

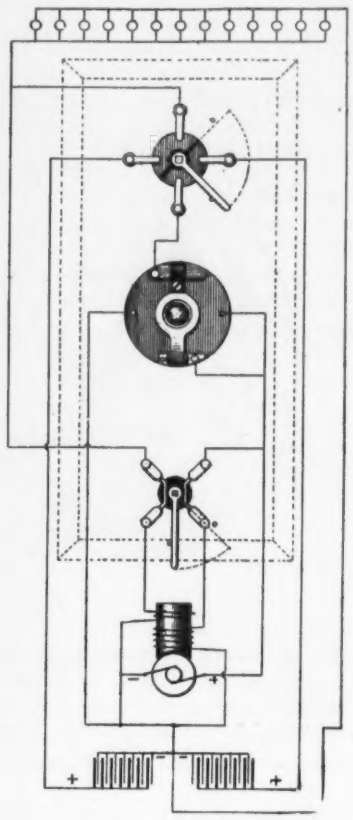


FIG. 3.—DIAGRAM OF CONNECTIONS.

tried with the generator sufficiently large to light three cars. This generator is of about twice the weight of the standard form of generator used to light single cars, and a form with two armatures and eight poles has been used to produce sufficient current to light three cars or more. This type of machine has, it is claimed, given entire satisfaction and can be used wherever a number of cars are always run together, such as a train which is never uncoupled. The battery can be carried on the one car which has on its axle the generator or the batteries can be carried separate in each car, all being charged by the one generator.

Western Electric Fans.

The general appearance of the Western Electric desk fans for 1903 is similar to that of the well-known type of the past year. Fig. 1 is an external view and Fig. 2 a cross-sectional view of the desk fan.

The open type of construction lends itself to pleasing appearance, accurate workmanship and high efficiency. The U-shaped field magnet with armature at the top gives a type of motor of graceful proportions. This style of construction allows a low pedestal and small encasing castings to be used, thereby making the weight of the motor unusually low, as a large proportion of the material used is "working material." The weight of the motor is further reduced by the use of a forged steel field magnet having the best magnetic properties.

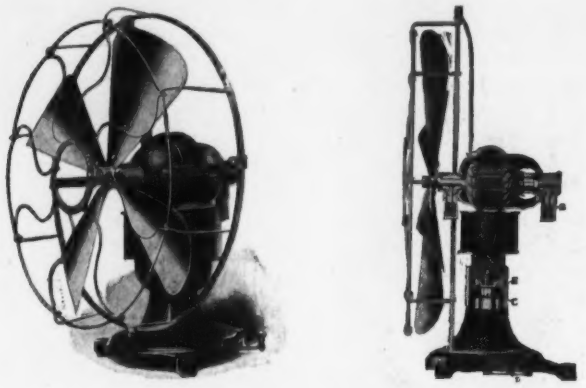
The armature is of the iron clad, drum type, wound with double silk-covered wire, insulated by pressboard tubes in the slots and pressboard washers over the end plates. The field coils are wound on pressboard spools and being exposed to the direct action of the moving air, an exceptionally low running temperature and conse-

quently a long life is insured to these important parts.

The armature of large diameter, wound with double silk-covered wire. The forged steel field magnet, the field coils of small diameter cooled by the moving air, the small air gap and careful shaping of pole tips, all combine to give the highest possible efficiency.

The brushes are of specially prepared graphite, circular in cross-section, and self-adjusting. The brush holders are a modification of the cartridge type and are provided with triggers which bear upon the end of the brush, pressing it against the commutator. They allow almost the entire brush to be used up and as there is no clamping, they will not break the brushes. The brushes can be readily renewed, without disturbing any of the electrical connections.

The speed regulating rheostat consists of an iron drum upon which is wound German silver wire, embedded in and protected by a complete coating of white enamel, doing away with any possibility of short-circuiting or grounding with the adjacent frame. The drum is mounted on a porcelain base carrying the speed-regulating switch and binding posts.



FIGS. 1 AND 2.—DESK FAN.

These motors are also made with the bracket form of mounting. The fan can be placed in any desired position by the adjustment of a single hand screw. The adjustment can be made while the fan is running at full speed. The motor frame swivels upon a ball and socket joint and has a horizontal range of 180° and vertical range of 45°.

The Western Electric ceiling fans are shown in Figs. 3, 4, 5 and 6. Fig. 3 is a cross-sectional view of the Standard ceiling fan. The motor is bipolar and has a slotted drum armature, the core being mounted directly on the shaft. The yoke and pole pieces are one casting of semi-steel.

The weight of the motor is supported by a strong cast-iron bracket fastened to the frame with machine bolts. The bracket also supports the upper bearing and a steel tube extending through the hollow armature shaft. This tube contains a six-wire cable made up of the leads for the chandelier lights and the wires connecting the speed-regulating rheostat to the switch. A rheostat gives three speeds to the fan.

These motors are wound for 110, 170, 220, 250 and 500 volts; the 170 and 250-volt motors are intended to run in groups of three and two in series on 500-volt circuits, in which case a wall switch rheostat for three-speed control is furnished.

Figs. 5 and 6 illustrate the "Western" ceiling fan for 1903. Fig. 5 is a cross-sectional view of one type and Fig. 6 a perspective view of another type. These types are similar in all respects, with the exception that the latter is not provided with a starting switch. Both are single-speed fans. The bipolar motor has an armature similar to the standard ceiling fan. They are also equipped with oil reservoirs, but they do not have the non-spillable feature of the standard wells, although the method of lubrication is the same. Before removing the fan from the ceiling hook, the oil is withdrawn from the wells by means of a small oil pump provided for this purpose.

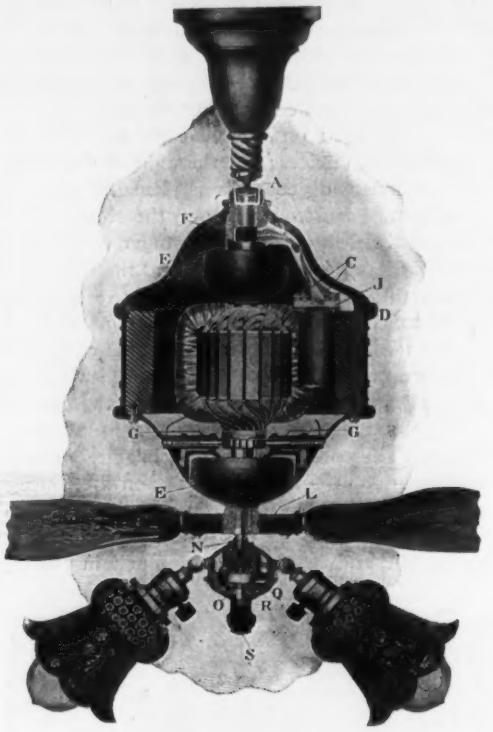


FIG. 3.—CROSS SECTION STANDARD CEILING FAN.

FIGS. 4, 5 AND 6.—CEILING FANS FOR 1903.

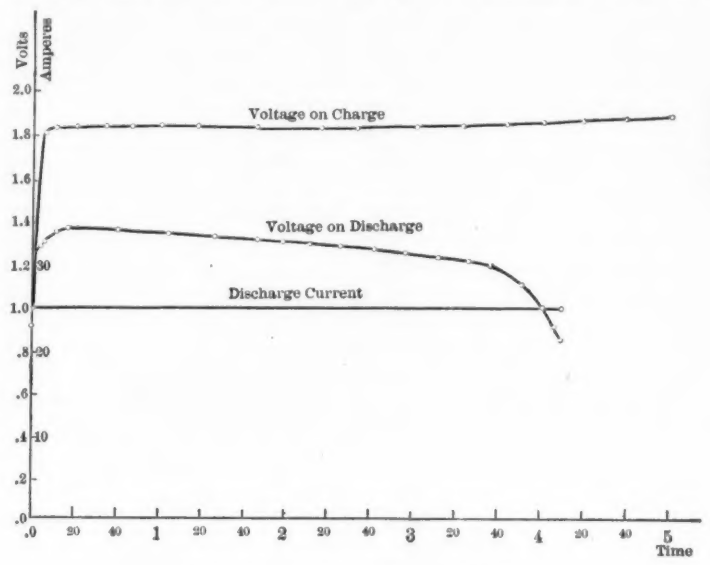
Central Station Use of "Hylo" Lamps.

A decidedly new departure has been made by the Missouri Edison Company, of St. Louis, in renewing "Hylo" lamps for their customers without charge, at the same basis as they renew ordinary 16-cp lamps of approved make. Mr. S. B. Pike is, we believe, the first central station manager to have the enterprise to adopt this practice; and the magnitude of the Missouri Edison system gives the innovation unusual importance. Writing to the Phelps Company, of Detroit, Manager Pike says: "In connection with our order to you for 500 lamps for immediate shipment and 300 lamps monthly until further notice, we beg to say that it is our intention to renew the lamps without any charge whatever on the same terms as we furnish free renewals for standard 16-cp lamps. The lamps which you send us on order should have a special distinctive label inside the stem to obviate possible fraud. In view of the advertising campaign which we now contemplate making in behalf of the Hylo lamps, we expect to need at least 10,000 of them to fully meet prospective demands."

Alkaline Storage Battery.

The Chicago Storage Battery Company, Fisher Building, Chicago, exhibited at the recent automobile show in the Coliseum Building, Chicago, an automobile of 28 cells of a new type of storage battery, for which strong claims are made. Full particulars of the cell have not been made public, but it is stated that it is of the alkaline type, that the positive elements are a combination of chemically transposed metals, that the negative element is the cell receptacle itself, and that "neither plates nor grids are used." The claim is made that a cell weighing slightly less than 6 pounds has a capacity of 100 amp-hours at an e.m.f. of 1.4 volts. Twenty-eight cells were exhibited at the automobile show in connection with a light runabout mounted on a speedometer. When the dial indicated a speed of 20 miles per hour, the battery delivered 30 amp, and it was claimed that this output could be maintained for three hours.

It is stated that the battery will receive a maximum charge in one or two hours, which feature also renders it particularly applicable to other than automobile work. For central station and street rail-



TEST CURVES OF STORAGE BATTERY.

way work, the batteries may be charged without injury to their full capacity, in not to exceed two hours, and when called upon, as occurs in central station work and street railway service, to take care of the peak of the load, they will readily and without any damage give a high rate of discharge.

The efficiency of the battery is claimed to compare very favorably with lead, and is proportional to the rapidity of charge or discharge. For example, with a cell having a capacity of 100 amp-hours (25 amp for 4 hours), there is no disturbance whatever in the electrolyte, nor gasing in any particular, nor heat developed, nor expansion of the elements, nor damage in any way to the battery; if given a charge as high as 45 amp for nearly four hours. The accompanying curves were plotted from tests made at Armour Institute.

Keeping Labor Costs in Factories.

The use of the calculagraph in telephone exchanges has already become a well-known and familiar feature of that branch of electrical work, enabling an exact account of the elapsed time of every conversation to be kept. Mr. Henry Abbott, the president of the Calculagraph Company, of New York, is now introducing the same ingenious appliance in a modified form as an aid in checking time on work in factories, as distinguished from time keepers' work, and ordinary time-recording appliances.

One of the functions of the calculagraph and its distinctive feature is that it mechanically subtracts the commencing time-of-day from the finishing time and records the number of hours and minutes a workman is employed on a job or piece of work. One calculagraph will make such records for a large number of workmen who are commencing and finishing without reference to consecutive order. The calculagraph also, incidentally, records the time of day the work commenced. Each record is a separate and individual one and there is no possibility of confusion. The calculagraph, moreover, makes no clerical errors. It has two handles or levers, one of which is operated at the time of commencing work and the other at the finish by the clerk who issues job cards with the work given out to the workmen and the cards used are adapted for use in card-filing cabinets. All of the calculagraph record cards belonging to any one job or product may thus be brought together in a bunch, even when a large number of operatives have been employed upon it, without any posting or copying of items and the total labor cost quickly and surely ascertained. Besides insuring accuracy as above explained the calculagraph will save, in a large mill, sufficient labor to repay its cost in a short time.

A New Type of "Button" Telephone Transmitter.

Due to the efforts of Mr. Ernest B. Fahnestock, a telephone engineer and apparatus designer of many years standing, a new type of telephone transmitter is being introduced which in appearance and construction presents quite an innovation and departs from the "solid back" form, as shown herewith. This "button" is entirely self-contained and is in itself a very efficient transmitter if placed on a table and spoken to.

It carries within itself two sound diaphragms, a carbon chamber

FIG. I.—BUTTON TELEPHONE TRANSMITTER.

and two electrodes and is designed to slip into the sound chamber carried at the end of the pivoted arm. Two cords are carried up through the inside of the arm to make the necessary electric connection. The "button" is not a permanent part of the sound chamber and may be removed and replaced by a new one at any time by removing the face plate and loosening the cord connections.

The "button" consists of a carbon chamber and two vibratable electrodes carried by mica washers. These washers are clamped by steel rings to opposite sides of the carbon chamber sealing it and making it moisture-proof. Each electrode has clamped to it a sound diaphragm that has no other support. This allows freedom for the periphery to vibrate, and insures the tuning of the two diaphragms to the same characteristic note. It also permits of a permanent ad-

justment of the electrodes, since the support of the carbon chamber and electrodes cannot be at variance with the support of the diaphragm as is sometimes the case with instruments of the solid back type.

Means are taken to secure flexibly the periphery of the sound diaphragm to the button after it has been clamped in place on the electrode. This flexible connection prevents the sound waves from impinging on its under side.

When the "button" is in place within the sound chamber the surface of the diaphragms is transverse to the line of progress of the sound waves and the "button" presents to the opening at the

FIG. 2.—BUTTON TELEPHONE TRANSMITTER.

mouthpiece only its edge. This prevents any mechanical injury and removes the necessity of having a protective button to the mouthpiece. The sound waves on entering the mouthpiece are divided by the edge of the "button," and impinging on the beveled sides of the sound chamber are deflected against the diaphragms.

The transmitter is constructed throughout of a special hard non-corrosive alloy and each part is cast in a brass mould which insures accuracy and interchangeability of all parts, while the non-corrosive

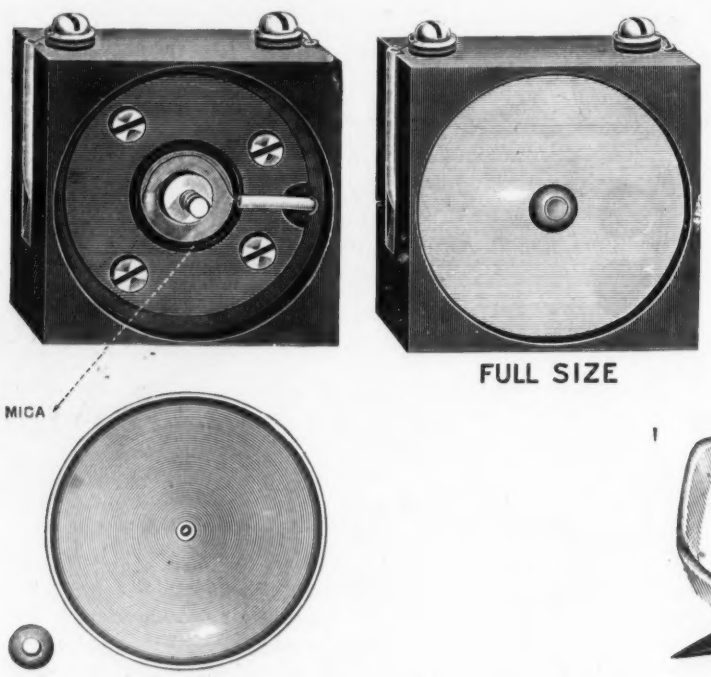


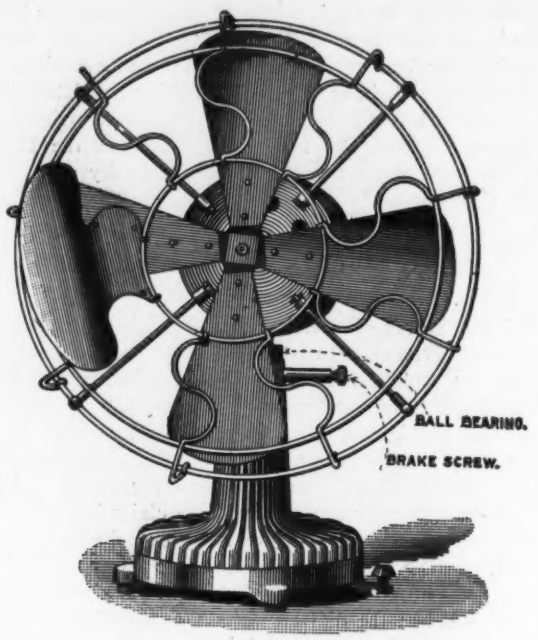
FIG. 3.—BUTTON TELEPHONE TRANSMITTER.

feature of the alloy entirely eliminates all possibility of corrosion by the moisture from the breath.

The finish is of black enamel, which would seem to insure a greater durability of finish than is ordinarily obtained by those instruments having extensive nickel-plated parts. The apparatus is being put on the market by the Fahnestock Transmitter Company, of 74 Cortlandt Street, New York City, which is also introducing some other telephonic improvements and specialties.

New Revolving Desk Fan.

A new form of revolving desk fan motor is being introduced this season by the Geo. C. Towle Manufacturing Company, of Lancaster, Pa., as shown herewith. The motor-carrying blade and guard revolves upon a ball bearing, the base remaining permanetly in one



REVOLVING DESK FAN.

position. The rotating motion upon its axis is produced by an air deflector mounted at a permanent angle upon the front of the guard. The perpendicular shaft of the thrust bearing extends through to the lower part of the base, where a movable contact is attached, similar to collector rings, on which run metal brushes, and mounted upon a porcelain base, which also holds the resistance used in regulating the speed of the fan motor proper. The revolving motion in connection with the motion from the fan blades distributes the air in a circular fashion. A friction brake is mounted upon the base and by screwing this in or out, any number of revolutions of the motor head can be secured. This works entirely independent of the speed regulation of the fan motor. The fan can be attached with plug and cord like any ordinary desk fan.

Lineman's Climber.

The Smith & Hemenway Company, of 296 Broadway, New York, is out with a linemen's new climber. It is stated to be made of a

LINEMAN'S CLIMBERS.

boracic steel, the toughest metal known, hardened and tempered by a secret process, and is covered with an extra heavy coating of white metal, which makes it absolutely rust-proof. The spur is welded in, making it practically one piece, and there is thus no possibility or danger of its coming loose. The loops are made in the forging.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was firmer in tone, but at the close of the week little was obtainable at less than 5 per cent. The closing quotations were 4¾ a 5 per cent. for 60 to 90 days, and 5 per cent. for 4, 5 and 6 months. The stock market was irregular throughout the week, with alternating periods of strength and weakness. In the main, however, the tendency was towards a lower level of values. Little attention was given to the market by the public. There was a fair amount of foreign buying of good railway bonds. All of the electrics and tractions shared in the general weakness of the market and closed, with one exception, with net losses on the week's business. Of the tractions, Brooklyn Rapid Transit closed at 67⅜, a loss of 2⅛ points, and Metropolitan Street Railway at 136¼, a loss of 3½ points. General Electric closed at the lowest point of the week—195—being a net loss of 4⅝; Westinghouse lost 1 point, closing at 210, and Western Union ⅛, the last quotation being 89½. American Telephone & Telegraph was also weak, closing at 83¾, which is 1 point off. American District Telegraph made a net gain of ½, the price for the entire week being 37½. Following are the closing quotations of March 3:

NEW YORK.

	Feb. 24.	Mar. 3		Feb. 24.	Mar. 3
American Tel. & Cable	83¼	83	General Electric	198	193⅛
American Tel. & Tel.	167	168	Hudson River Tel.	..	..
American Dist. Tel.	37⅛	37	Metropolitan St. Ry.	137¼	135½
Brooklyn Rapid Transit	68¾	68⅜	N. E. Elec. Veh. Trns.	..	⅛
Commercial Cable	..	..	N. Y. & N. J. Tel.	..	186
Electric Boat	20	20	N. Y. E. V. T. Co.	10	9½
Electric Boat pfd.	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	2⅞	Western Union Tel.	89¼	89
Electric Vehicle	6	3¾	Westinghouse com.	212	200
Electric Vehicle pfd	11	11	Westinghouse pfd.	210	225*

BOSTON.

	Feb. 24.	Mar. 3		Feb. 24.	Mar. 3
American Tel. & Tel	167⅛	167	Western Tel. & Tel. pfd.	99⅛	99⅛
Cumberland Telephone	125	..	Mexican Telephone	2¼	2⅛
Edison Elec. Illum.	..	295	New England Telephone	137	137
General Electric	199	194	Westinghouse	105	102
Western Tel. & Tel	25	23	Westinghouse pfd.	105	102

PHILADELPHIA.

	Feb. 24	Mar. 3		Feb. 24	Mar. 3.
American Railways	52	50¼	Phila. Traction	98¼	98⅜
Elec. Storage Battery	..	..	Phila. Electric	7⅞	7⅛
Elec. Storage Battery pfd	..	81*	Pa. Electric Vehicle	..	..
Elec. Co. of America	9⅛	9⅛	Pa. Electric Vehicle pfd	3	..

CHICAGO.

	Feb. 24.	Mar. 3		Feb. 24.	Mar. 3.
Central Union Tel.	..	..	National Carbon pfd.	98	96
Chicago Edison	..	159	Northwest Elev. com.	..	29
Chicago City Ry.	222	217	Union Traction	10	9¼
Chicago Tel. Co.	158	155	Union Traction pfd.	44	42¾
National Carbon	25	24			

*Asked.

MINNEAPOLIS GENERAL ELECTRIC.—At a meeting of the stockholders of the Minneapolis General Electric Company, held on February 20, 1903, it was voted to increase the preferred stock of the company by 2,500 shares, or from $750,000 to $1,000,000, par value, which will leave the capitalization as follows: Common stock, $1,500,000; preferred stock, $1,000,000; first mortage 5 per cent. bonds, $1,204,000; reserved to redeem underlying 6 per cent. bonds, $765,000. These 2,500 shares will be offered at par, to present holders of preferred and common stock, giving each stockholder the right to take one new share for each nine shares of stock held by him. The money thus raised will be used for the purchase of a new 1,000-kw direct-connected condensing unit and the installation of some 25 duct miles of conduit and electric cable. The earnings for the years 1901 and 1902 have been as follows:

	1902.	1901.	Changes.	
Gross	$500,586	$405,634	Inc.	$94,952
Expenses	265,444	202,345	Inc.	63,098
Net	$235,142	$203,288	Inc.	$31,853
Fixed charges	98,409	97,050	Inc.	1,359
Net profits	$136,732	$106,238	Inc.	$30,494

COMMERCIAL CABLE ANNUAL REPORT.—At a special meeting of the stockholders of the Commercial Cable Company this week it was voted that the capital stock be increased from $15,000,000 to $25,000,000. Over 100,000 shares were represented. The shareholders wished to put the directors in a position to issue new stock for the extension of the company's system as the growth of the company's business warrants from time to time and for other purposes. The annual meeting of the stockholders was held also and the annual report shows:

	1902.	1901.
Gross earnings	$10,208,192.71	$9,679,794.16
Net earnings	2,383,588.83	2,259,896.61
Last year's balance added	2,514,193.19	2,480,962.79
Interest dividends and reserve	2,366,664.00	2,350,358.43
Balance carried forward	$147,529.19	$130,604.36

Vice-President Ward was cordial in his references to wireless telegraphy, and expressed the belief that submarine cables had nothing to fear from its competition.

BELL TELEPHONE.—It is stated from Boston that the American Telephone & Telegraph Company's annual report will show for the year ended December 31, 1902, net earnings of about $10,000,000 after the payment of all expenses, interest and taxes. This sum is equivalent to about 9 per cent. on the $109,685,000 stock at present outstanding. It is alleged that Mr. J. P. Morgan, having nothing else on his mind is taking a very lively interest at the present time in the American Telephone & Telegraph Company. It is said that he represents the largest stock interests in the compauy and that next month may find one of his active lieutenants vice-president and general manager in charge of the expenditures for new construction, which it is expected will this year be the largest in the history of the company. It is said that the Morgan interest in the telephone company does not exceed $15,000,000.

ST LOUIS LIGHTING.—The Laclede Gas & Electric Company will pass into the control of the North American Company of New Jersey on March 1. On this date 10 per cent. of the purchase price will be paid, and on April 1 90 per cent. The capital stock of the Laclede Company is $11,000,000. It is reported that negotiations have been completed for the purchase of the Missouri Edison Company. At present it is capitalized at $12,000,000, but it is planned to increase the capital stock to $100,000,000 owing to varied interests that are coming into its control. The price paid for the two companies was $12,825,000. Laclede common was put in at $100 a share and the preferred at $125. Missouri Edison common sold for $25 and the preferred at $60.

UNITED STATES LIGHT & HEATING.—At the annual meeting of the United States Light & Heating Company, held at Jersey City, the following new directors were elected: R. H. Beach, Leroy W. Baldwin, Joseph Leiter, W. K. Gillette, A. Sandford Adler, C. S. Drummond. The old directors who were re-elected are Charles S. Furst, Wallace Young and John J. Gilbert. Mr. R. H. Beach was elected president of the corporation. Mr. W. J. Arkell was elected vice-president. Mr. Charles S. Furst was elected secretary and treasurer. Mr. A. Sandford Adler was elected general manager. A trial car was run successfully on the New York Central this week.

WESTERN ELECTRIC EARNINGS.—After the adjournment of the directors of the Western Electric Company, who met recently to declare a stock dividend of 20 per cent., it was learned that the gross business for the year exceeded $29,000,000, and that the Bell telephone estimate for new work in 1903 would call for at least $38,000,000 of money authorized, but probably only $25,000,000 would be spent during the year. The company now has factories in the leading cities of the world and on its pay-roll are over 13,000 employees.

DIVIDEND.—The directors of Detroit United have declared the regular quarterly dividend of 1 per cent. on the capital, payable April 1. The Chicago City Railway has declared the regular quarterly 2¼ per cent. dividend. Directors of South Side Elevated, Chicago, have declared the regular quarterly dividend of 1 per cent., payable March 31. A dividend of $2 per share has been declared on Philadelphia Traction Company stock, payable April 1.

BALTIMORE UNITED RAILWAY & ELECTRIC COMPANY. reports for the year ended December 31, 1902, as follows: Gross, $5,041,275; expenses, $2,252,133; net, $2,789,141; charges, $2,637,115; balance, $152,026; dividend from lighting company, $53,405; total credited to surplus, $205,431; previously credited, $128,006; total surplus, $333,438.

KINGS COUNTY ELECTRIC INCREASE OF CAPITAL.—At a special meeting of the shareholders of the Kings County Electric Light & Power Company called for March 18, it is expected that a proposition to increase the capital stock $2,500,000 will be voted on.

RECEIVER FOR THIRD RAIL.—The Murphy Safety Third Rail Company has passed into the hands of a receiver, Dudley Farrand, of Newark, being appointed by Vice Chancellor Stevenson, of New Jersey.

RECEIVER FOR MICHIGAN TELEPHONE COMPANY.—The Union Trust Company, of Detroit, was, on February 23, appointed receiver for the Michigan Telephone Company, on the application of the Old Colony Trust Company, of Boston. The telephone company, it is stated, defaulted last July in the payment of its interest coupons amounting to $118,000 on its mortgage debt. Three months afterwards the Old Colony Trust Company filed a bill in the United States Court to foreclose the trust mortgage. On January 1 of this year the Michigan company defaulted in the second instalment of interest coupons, so that there was due for arrears of interest to the bondholders represented by the Old Colony Trust Company over $240,000.

MISSOURI & KANSAS TELEPHONE COMPANY.—A Bell sub-company reports for the year ending December 31, 1902:

	1902.	1901.	Changes.
Gross	$1,228,436	$1,056,638	Inc. $171,798
Operating expenses	956,993	814,790	Inc. 142,203
Balance	$271,443	$241,848	Inc. $29,595
Depreciation	50,000	50,000	.....
Net	$221,443	$191,847	Inc. $29,596

The company now has 53 exchanges, including branches, and 25,362 exchange stations.

THE CLEVELAND & SOUTHWESTERN TRACTION COMPANY, which is the consolidation of the Cleveland, Elyria & Western Railway and the Cleveland & Southern Railway, has filed a mortgage for $3,000,000 in favor of the Federal Trust Company, of Cleveland. This covers the entire bonds of the combined properties.

Commercial Intelligence.

THE WEEK IN TRADE.—The jobbing demand for goods at leading markets has been enlarged as a result of the spring-like weather conditions, and the same cause has favored expansion in retail trade. Building activity has been generally resumed with more favorable weather. In commenting upon the trade situation, *Bradstreet's* says: "Perhaps the most notable feature of the week's developments is the strength of the price situation, this not merely with regard to producers' and manufacturers' quotations, but also as to rates paid by final consumers. The one debatable element in the 1903 spring trade outlook has heretofore been the uncertainty as to how the higher level of prices would act upon consumptive demand. This situation is apparently solving itself with astonishingly little friction. In fact, the conviction seems to be growing that a higher level of quotations has been rendered necessary, and these are being accepted with little protest. Dullness in collections is noted at many centers, but this is a usual February condition. A strong demand for currency came from Western points, which caused heavy shipments from the East for this season of the year. Transportation lines have been rather favored by open weather conditions this year, as compared with February a year ago, and large aggregate gains in earnings for the month are predicted. There is yet evidence of railroad congestion in the reports that a large quantity of winter wheat still remains to come forward, being held back on account of the scarcity of cars. Prices of primary staples show a firmer tone in pig iron at home and abroad, advances in prices of iron and steel bars, wire and nails, the highest price paid for raw cotton in three years, a continuance in the advance of copper, to the highest point for over a year past, and a renewal of the advance in tin. Other staples have tended to hold their strength, and the steadiness of many of the leading commodities is second only to the aggressive strength shown by the products above mentioned. Structural material is active, and the railroads are buying freely. A large amount of construction work is looked for this year. The conditions in the copper market are unchanged. Copper shares and the price of copper have advanced simultaneously. Prices are nominal, ranging from 13⅛ to 13⅜c. for Lake and electrolytic; 12⅞ to 13⅛c. for casting stock, and 12⅝c. for Standard. The business failures for the week ending February 26, as reported by *Bradstreet's*, numbered 185, against 188 the week previous, and 204 the corresponding week last year.

WESTINGHOUSE STEAM TURBINES.—A new turbine shop has recently been put into service by the Westinghouse Machine Company, who have largely increased their manufacturing facilities in this new field of work. Particulars concerning a few of the more recent turbine installations may be of interest. Prominent among railway plants are those of the Metropolitan Railway Company and the Metropolitan District Railway, of London, aggregating 50,500 kw for operating the London Tube and surface railway systems. The former plant will employ three 3,500-kw units, and the latter eight 5,000-kw units, the largest turbine machinery on record. Two American railway installations are those of the Cleveland, Elyria & Western Railway Company and the Consolidated Railways & Lighting Company, of Wilmington, N. C., each of which will generate alternating current at a central power station, employing transmission lines and rotary converter sub-stations along the right of way. Several prominent lighting installations comprise the Hartford Electric Light Company, two 750-kw units, replacing the engine-driven units, 1,500 kw already installed; West Pennsylvania Railways & Lighting Company, Pittsburg, Pa., three 1,000-kw units, for supplying the entire district between McKeesport and Connellsville; Columbus (Ohio) Municipal Plant, three 400-kw units; Roslyn (L. I.) Light & Power, 800 kw; Citizens' Light, Heat & Power Company, Johnstown, Pa., three 400-kw units; the Rapid Transit Subway, New York, three 1,250-kw units, supplying current for lighting the entire subway, the 47 underground stations, and the immense power house at Fifty-ninth Street, Manhattan; Portsmouth (Ohio) Railway & Lighting Company, three 400-kw units, and the Rockland Light & Power Company, Nyack, N. Y., 400 kw. A number of these plants furnish considerable amounts of electric power to manufacturing establishments employing motor-driven machinery. Other installations employed exclusively for industrial power establishments comprise the De Beers Consolidated Mines, Kimberly, South Africa; two 1,000-kw units for lighting and operating mine machinery; Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., two 750-kw units for shop power; B. F. Goodrich Company, Akron, Ohio, one 750-kw unit for shop power, 400 kw already in operation; Saco & Pettee Machine Shops, Biddeford, Maine, two 400-kw units for operating shops; S. D. Warren & Co., Cumberland Mills, Maine, 400 kw for shop power, relaying steam and water plant, and the Yale & Towne Manufacturing Company, Stamford, Conn., 400-kw unit, duplicating the turbine equipment already in operation. A recent installation for the Goshen & Indiana Traction Company comprises five 400-kw units. The entire station will be operated from turbine machinery, and current will be used for light and power work.

PAWLING & HARNISCHFEGER, builders of electric traveling cranes, Milwaukee, Wis., advise that they find a very satisfactory demand for their products during the first two months of the new year. The record of an average of one crane order per day is still maintained and the use of day and night shifts in their works is still required. Orders come in freely from all sections, though the iron and steel industries of Pennsylvania and Ohio continue being the heaviest buyers. Steam railroads are more in the market than heretofore and the inquiries from electric railroads and electric lighting plants indicate a growing desire for crane equipment. The orders booked since the first of the year are partly represented as follows: Chicago & Eastern Illinois Railroad Company, Danville, Ill., 3 cranes; Western Tube Company, Kewanee, Ill.; the Westinghouse Machine Company, East Pittsburg; South Penn Oil Company, Folsom, W. Va.; the Pittsburg Plate Glass Company, Ford City, Pa.; Ansonia Brass & Copper Company, Torrington, Conn.; Fairbanks, Morse & Co., Beloit, Wis.; St. Paul Foundry Company, St. Paul.; the Ingersoll-Sergeant Drill Company, Phillipsburg, N. J., 14 cranes; American Bridge Company, Ambridge Plant, Economy, Pa., 5 cranes; the Standard Steel Works, Burnham, Pa.; City of Boston Water Department, Boston; Beloit Iron Works, Beloit, Wis.; International Steam Pump Company, Laidlaw-Dunn-Gordon Works, Elmwood Place, Ohio; Wheeling Steel & Iron Company, Benwood, W. Va.; the Coe Brass Manufacturing Company, Torrington, Conn.; the McConway & Torley Company, Pittsburg; the Ironton Engine Company, Ironton, Ohio, 2 cranes; Joseph T. Ryerson & Son, Chicago; Hammond Iron Works, Struthers, Pa.; Cambria Steel Company, Johnstown, Pa.; American Bridge Company, Pencoyd Plant, Pencoyd, Pa.; C. A. Lawton & Co., De Pere, Wis.; Perry-Mathews-Buskirk Stone Company, Bedford, Ind., 2 cranes; the Toledo Machine & Tool Company, Toledo; American Sheet Steel Company, Wellsville Works, Wellsville, Ohio; Landis Tool Company, Waynesboro, Pa., 3 cranes; Goodman Manufacturing Company, Chicago.

SUPPLIES WANTED FOR TURKEY.—Mr. Simon W. Hanauer, United States Deputy Consul General, reports that the administration of the postal and telegraphic service at Constantinople is open for bids on materials required by it, among which are 60,000 kg iron wire, 4 mm diameter; 20,000 kg bronze wire, 2 mm diameter; 27,000 insulators, partly with and partly without iron; 480 American machine augers and numerous other articles for telegraphic purposes. On awarded contracts 10 per cent security will have to be furnished by the successful bidder.

MOTORS FOR SAW FACTORY.—The Northern Engineering Company, Incorporated, has secured a contract for the installation of motors in the saw factory of the Jennings & Griffin Manufacturing Company, Port Jervis, N. Y. The motors are of General Electric induction type. There will be one 75-hp, one 20-hp, one 15-hp, one 5-hp and one 2-hp machine. Power will be derived from the new hydraulic plant at Rose's Point.

FRANK B. COOK, of Chicago, has been making a great success of the business of manufacturing telephone protective devices, switchboards and distributing terminals, which he started about eight months ago. It was at that time that he secured quarters at 240 West Lake Street, Chicago, ordered machinery, and started to make the necessary special tools and patterns, but it was only about four months ago that he was able to accept orders. The Kinloch Telephone Company, St. Louis, have purchased of him 62 cable terminals and protectors, the Home Telephone Company, of Los Angeles, has ordered 295 pole-top terminals and 180,000 tubular line fuses; the Automatic Electric Company, of Chicago, has ordered 19,500 pairs of protectors; the Home Telephone Company, of Dayton, Ohio, 6,000 pairs; the Illinois Telephone & Telegraph Company, for its new exchange in Chicago, 2,000 pairs, and the Citizens' Telephone Company, of Grand Rapids, 5,500 pairs. The large telephone manufacturing companies are also favoring Mr. Cook with orders for the equipment of exchanges which they have under contract. The North Electric Company has ordered the distributing terminals and protectors for exchanges at Worcester, Ohio, Eureka Springs, Kansas, Oneonta, New York, Bellefontaine, Ohio, and several other places. The Kellogg Switchboard & Supply Company has ordered 9,000 pairs of protectors, 8,000 of which are for the Home Telephone Company, of Los Angeles. The Stromberg-Carlson Telephone Company has placed large orders for distributing boards and protectors for some ten exchanges in various parts of the country. Adding to this a number of small orders, Mr. Cook has received orders all told for 110,000 heat coils, 240,000 cable arresters and 60,000 tubular line fuses.

TURBINE PLANTS FOR NEW ENGLAND.—The Massachusetts Electric Companies have contracted with the General Electric Company for ten 3,000-hp and three 1,000-hp steam turbines, direct connected to electric generators. The ten 3,000-hp turbines will be installed in three stations—Fall River, Quincy Point and Danvers, Mass.—superseding 13 of the engine-driven stations now operated by the concern. The turbines are of the Curtis vertical type run at only 750 r.p.m., taking steam at 175 pounds pressure at the turbine nozzle. The generators are mounted directly on the upper end of the turbine shaft, without gears or reducing mechanism, and are rated at 2,000 kw each. Adjoining their old power house at Newport, R. I., the companies have built a new one, 101 ft. square, in which the three 1,000-hp turbines are being installed for lighting and railway power work, and will replace the old plant, which contains a varied assortment of small belted Edison and Thomson-Houston units. The generators are 500-kw, three-phase, 2,500-volt General Electric machines and run at the turbine speed of 1,800 r.p.m. The boiler equipment comprises four 350-hp Aultman & Taylor water tube boilers, Green fuel economizers, and Schmidt superheaters.

COAL-HANDLING EQUIPMENT FOR LONDON.—The John A. Mead Manufacturing Company, 11 Broadway, has just secured the important contract for the belt-conveying equipment to be utilized for the handling of coal at the Chelsea power station of the Metropolitan Underground Railway, in which Charles T. Yerkes is interested. This equipment will be the largest of its description in any foreign country. There will be three belts all electrically operated. The one to be installed on the water side will be 250 ft. in length, with a capacity for handling 250 tons hourly. The two other conveyors are to run over the bunkers and are each to be 500 ft. long. They will each be capable of taking care of 120 tons per hour. The belts will be driven by alternating-current motors. The machine on the dock will be 35 hp. The motors to operate the bunker belts will be 20 hp each. The motors have not yet been purchased by the Mead people. The structural material for the plant will be purchased in England. The coal-handling equipment complete will represent an expenditure of nearly $100,000.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., reports a volume of business fully equal to the corresponding period of last year and an increasing demand for its electric traveling cranes. Among electric cranes recently installed, ranging in capacity from three tons to forty tons, are the following: C. D. Jackson & Co., 25-ton crane; Detroit Ship Building Company, 5 cranes, 5 to 40 tons; Allis Chalmers Co., Milwaukee, 12 cranes; American Ship Building Company, 3 electric cranes; P. A. Clum & Co., C. & G. Cooper Co., Macbeth Iron Company. It has also installed hand-power cranes of the traveling or jib type in the works of the Carpenter Steel Company; Insurance Stove & Range Company, Western Gas Construction Company, Mathewson Alkali Works, Colburn Machine Tool Company, 5 cranes; American Car & Foundry Company, Berwick, Pa., 24 cranes. It reports an increased demand for cranes and foundry machinery for export, as compared with the corresponding period of last year.

RECENT WESTINGHOUSE PLANTS.—The Great Northern Portland Cement Company, of Detroit, will equip its new plant throughout with electrical apparatus and has recently purchased from the Westinghouse Electric & Manufacturing Company 23 direct-current motors, ranging in size from 5 to 50 hp. These motors will be applied to driving cement machinery of all kinds. The Cleveland Hardware Company is installing a complete electrical equipment for the operation of its plant, and has recently purchased from the Westinghouse Electric & Manufacturing Company one 75-kw and one 100-kw, two-phase alternators, together with exciters, switchboard, ten 20-hp motors and two 10-hp motors. The plant is already in operation and is doing very satisfactory work. George S. Rider & Co. are the engineers.

LIGHTING OUTFIT FOR BRAZILIAN DOCKS.—The Lidgerwood Manufacturing Company, 96 Liberty Street, which concern recently secured a valuable contract for cableways, etc., in connection with the Manaos harbor improvements at the mouth of the River Amazon, has placed an order for a small lighting equipment for shipment to that Brazilian port. Mackenzie & Quarrier, 203 Broadway, have obtained the order for a 65-hp Harrisburg standard simple engine. The generator will be 37½ kw, Westinghouse direct-connected. Considerable electrical equipment will be used at Manaos before the dock improvements are finally completed. The work is being undertaken by a British concern in which Carlos Booth, of the Booth Steamship Line, 88 Gold Street, New York, is primarily interested.

BULLOCK EQUIPMENT FOR RAILROAD SHOPS.—The Bullock Electric Company, through its New York offices in the St. Paul Building, has taken a contract for two Bullock 750-kw, 25-cycle, three-phase alternating generators, engine type, 94 revolutions, for installation in the New York Central & Hudson River Railroad shops at Weehawken. There will also be two Bullock exciters of 50 kw capacity each. Through the Cincinnati office a contract has been obtained for 45 motors of various sizes for installation in the Columbus (Ohio) shops of the Pennsylvania Railroad.

STROMBERG-CARLSON TELEPHONE CONTRACTS.—The Calhoun County Telephone Company, of Kampsville, Ill.; the Kilbourn Telephone Company, of Kilbourn, Ill.; the Shelby County Mutual Telephone Company, of Strasburg, Ill., have purchased their telephones and switchboards from the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The Secor Telephone Company, of Seçor, Ill., has purchased an equipment from the Stromberg-Carlson Telephone Manufacturing Company, also the Danforth Telephone Company, of Danforth, Ill.

NEW YORK RAPID TRANSIT ORDER.—The Interborough Rapid Transit Company, of New York City, awarded the contract for the electrical equipment of the trains on the Underground this week. The General Electric Company received the order for all of the train control, which will be substantially the same as that now used on the Manhattan Elevated Railway. The contract for the motors on the cars was divided equally between the General Electric Company and the Westinghouse Company. The total amount involved was about $2,000,000.

EQUIPMENT FOR STONE-CUTTING PLANT.—Senator W. A. Clark's stone-cutting plant at Ravenswood, L. I., is to be electrically operated. The Westinghouse Electric & Manufacturing Company will supply the generators—one of 100 kw and another of 75 kw capacity. These machines will be direct-connected to 150-hp and 120-hp Harrisburg standard simple engines. Several Westinghouse motors have also been ordered. The equipment is intended to be utilized for both power and lighting purposes.

EQUIPMENT FOR PERU.—F. A. Mitchell, of Iquitos, Peru, is now in New York with a view to purchasing equipment for the Iquitos Electric Light & Tramway Company, which is to erect a plant for the purpose of lighting the city of Iquitos. An electric traction system about 6 miles in length is also to be constructed between the docks and the heart of that Peruvian city. Mr. Mitchell may be found during the early part of the day at the office of the Export Club of America, 82-88 Wall Street.

LIGHTING EQUIPMENT FOR NEW KNICKERBOCKER HOTEL.—Mackenzie & Quarrier, 203 Broadway, have secured the contract for the engines to be installed in connection with the lighting plant for the Knickerbocker Hotel, now under construction, at Forty-second Street and Broadway. There will be three Harrisburg 300-hp tandem compound engines. The generators, direct-connected ones, are to be of 200-kw capacity each. They will be built by the Sprague Electric Company.

AFTER JAMAICA LIGHTING FRANCHISE.—The West India Electric Company, Limited, a London concern, is seeking a concession for the electric lighting of the city of Kingston, Jamaica, British West Indies.

CONTRACTS FOR RARITAN RIVER PLANT.—The National Fire Proofing Company, 170 Broadway, is contemplating the erection of an extensive electric plant for the purpose of operating its works along the Raritan River, N. J.

CONSTRUCTION WORK BEGUN ON NEW CUBAN LINES.—The Insular Railway Company, which was recently incorporated under the laws of New Jersey with a capital of $2,500,000 for the purpose of constructing and operating an extensive system of light railways in Cuba, has begun work on the first section of the lines which will all radiate from Havana. The line now under construction will operate between the Cuban capital and Mariel, a favorite seaside resort, 30 miles west from Havana. This section is to be completed in June. German steel rails are being laid 4 ft. 8½ gauge. The other lines to be constructed will run to Congrejeras, Managua and Guines. In all more than 100 miles will be built. Both passenger and freight traffic is intended to be handled. The Insular Company is controlled by the interests identified with the Havana Electric Railway Company. Power to operate the Mariel section will be derived from the Havana company's central power station, which will ultimately be enlarged so as to furnish current for the other insular lines to be built.

THE ALBERGER CONDENSER COMPANY, 95 Liberty Street, New York, has acquired control of the Newburgh Ice Machine & Engine Company, Newburgh, N. Y. This engine company has been long and favorably known as builders of Corliss engines, ice machines and similar high-class machinery. It is understood to be the intention of the Alberger Condenser Company to devote this works principally to the manufacture of improved condensers, vacuum pumps and Corliss pumping machinery, which they are using extensively in connection with high-vacuum condenser installments. The recent developments in this class of work all tend toward the improvement of the parts that make up the condensing equipment. The Alberger Condenser Company still retains close connection with the Quintard Iron Works, foot of East Thirteenth Street, New York City, but rapidly-increasing business has made it necessary to obtain additional facilities for the manufacture of special lines of work.

EQUIPMENT FOR ALABAMA PLANT.—Some of the contracts for the equipment to be installed in the plant which is to furnish light, power and water for Sheffield & Tuscumbia, Ala., have just been awarded through L. H. McIntire, at one time manager of the Savannah (Ga.) street railway system, who may be found at the offices of Henry Parsons in the Morris Building. The boiler contract has been allotted to Wickes Brothers, Saginaw, Mich. There will be two units of 300 hp, vertical type. The engines, one 450-hp tandem compound condensing and another of similar type, having a capacity of 375 hp, have been ordered from Woolston & Brew, 39 Cortlandt Street. They will be of Brown (Milwaukee) build. The contract for a triple-expansion pumping engine, capable of handling 4,000,000 gallons, together with the condensers and small pumps, has been let to the Worthington branch of the International Steam Pump Company, 114 Liberty Street, New York.

NEW GENERAL ELECTRIC POWER STATION.—The General Electric Company is to construct a new central power plant at Schenectady, N. Y., which will be equipped with the Curtis vertical turbines. The plans drawn up will permit of a boiler capacity of nearly 20,000 hp. The initial boiler equipment, however, will only comprise eight units of 517 hp each. This contract has been secured by the Stirling Company, of Chicago, Ill., through its New York offices. The boilers will be high-pressure, with attached heaters. The condensers and pumps have been ordered from the International Steam Pump Company, 114 Liberty Street. The contract for the coal and ash-handling plant, which will be built so as to handle both materials simultaneously, has been awarded to John A. Mead & Co., 11 Broadway. This equipment will have an hourly capacity of 90 tons. The structural material for the building is to be supplied by the American Bridge Company, of New York.

EQUIPMENT FOR INSULATED WIRE PLANT.—The Hungerford Electric & Manufacturing Company, of which concern John Beaver, of the Metropolitan Street Railway, is president, and H. C. Willis, connected with the American Steel & Wire Company, is secretary, has let the complete contract for the equipment of its temporary power plant at Essex, N. J., to H. B. Coho & Co., Engineering Building. The Essex plant will manufacture insulated wire on an extensive scale. The contract calls for a 200-hp high-pressure boiler, which is to be built by the Stirling Company. The De Laval Steam Turbine Company, 74 Cortlandt Street, has been allotted the order for a turbine of 125 hp capacity. The contract also calls for the installation of 80 motors of 5 hp each. These machines will be manufactured by the Keystone Electric Company, of Erie, Pa. The Hungerford Company is to build a permanent power plant having a capacity of 1,000 hp.

AMERICAN BALL ENGINE ORDERS.—The American Engine Company, Bound Brook, N. J., through its New York offices, E. S. Boyer, manager, has secured an order for a 120-hp American Ball duplex compound engine for direct connection to a 75-kw Westinghouse dynamo. The equipment will be used for both light and power in the Hoboken (N. J.) shops of the Keuffel & Esser Company, 127 Fulton Street, New York. The H. A. Matz Color Works, Newark, N. J., are to be equipped with a 12-in. x 11-in. American Ball simple engine for direct connection to a Crocker-Wheeler dynamo of 50 kw capacity. A 11-in. x 12-in. simple engine is to be furnished the Standard Rock Candy Company, New York, for direct connection to a 35-kw Triumph dynamo.

BALL ENGINE ORDERS.—The engines for the electric plant of the new First National Bank Building, of Chicago, will be furnished by the Ball Engine Company, Erie, Pa. There will be four 350-hp vertical cross-compounds, direct connected to Crocker-Wheeler generators. This building will be one of the finest in the country. Mr. R. T. White, Bayonne, N. J., has recently purchased from the Ball Engine Company a 160-hp direct-connected outfit for electrical purposes. A new direct-connected outfit of 80 hp will soon be installed in the Bijou Building, Pittsburg, Pa., the Ball Engine Company furnishing the engine and the Westinghouse Electric & Manufacturing Company the generator. The Diebolt Brewing Co., Cleveland, Ohio, have recently purchased a direct-connected unit, the Ball Engine Company, Erie, Pa., furnishing the engine, the Triumph Electric Company, Cincinnati, the generator. The electric light plant at Carrington, N. D., has placed in operation a direct-connected unit, the Ball Engine Company furnishing the engine, and the Northern Electric Manufacturing Company, Madison, Wis., the generator. Two 200-hp horizontal tandem compound, direct-connected engines have been ordered for the Mercantile Library, Cincinnati, Ohio, from the Ball Engine Company.

BRITISH CONDUIT FOR JAPAN.—Takata & Co., 10 Wall Street, have secured the contract for the supplying of the interior lighting conduit to be installed in the new Yokohama Specie Bank at Yokohama, Japan. The material will be purchased in England in view of better prices having been submitted by a London concern—the Conduit & Insulation Company—than were offered by firms on this side. The building referred to will be one of the largest and most elaborate in the far east. The structural material—about 1,500 tons—is being furnished by the American Bridge Company. The contracts for the electrical equipment are still pending and are not expected to be awarded before fall.

BIG ELECTRIC COAL-HANDLING HOIST.—The Robins Conveying Belt Company, Park Row Building, has placed a contract with the Lidgerwood Manufacturing Company, 96 Liberty Street, for a large coal-handling hoist, which will be operated by electricity. The equipment is intended to be installed in the Kingsbridge (N. Y.) power station of the Union Railway Company, the entire contract for the coal-handling plant for which has been undertaken by the Robins Company. The hoist will be of direct-acting, double-drum type. It will be operated by a 200-hp General Electric motor.

J. G. WHITE & COMPANY, LIMITED, of London, England, have received the contract for the complete construction of the Shipley tramways, including permanent way, overhead line, tramcars and equipments and cables. This contract amounts to £65,000. The Shipley contract is the first section of the Mid-Yorkshire scheme, for which powers are at present being obtained. The total estimated cost amounts to £450,000.

JAPANESE ELECTRIC TRACTION PROJECTS.—An electric traction system is to be constructed between Osaka, the principal commercial city in the Japanese empire, and the city of Kobe. The road will be about 20 miles in length. It is also proposed to build an electric line in Kobe. T. Ikeda, chief engineer of the Osaka Electric Light Company, is primarily interested in both projects.

FIFTY CARS ORDERED FOR HAVANA ROAD.—The Havana Electric Railway Company, 52 Broadway, has just placed a contract for fifty cars. The bodies will be built by the Niles Car Company, of Niles, Ohio. The trucks will be supplied by the McGuire Manufacturing Company, of Chicago, Ill. They will be equipped with 25-hp, double motors of General Electric 52 type.

CHINESE ELECTRICAL PROJECT.—Arnhold, Karberg & Co., of China, with offices at 50 Wall Street, are acting as agents for a Tien-Tsin syndicate, which proposes to furnish current for lighting and general power purposes in the City of Pekin. In the first instance it is intended to confine operations within the legation quarter of the Chinese capital.

HAVANA SYSTEM TO BE EXTENDED.—The Havana Electric Railway Company, which at present operates 36 miles of electric road in the city of Havana, Cuba, contemplates an extension of six miles to its system within the city. It is proposed to construct a steel viaduct about 1,500 ft. long.

ANOTHER JAPANESE TRACTION CONTRACT AWARDED.—The Japanese house of Takata & Co., 10 Wall Street, has been awarded an important contract for the complete equipment of a new Japanese electric traction enterprise. Details will be given in due course.

General News.

THE TELEPHONE.

WALCOTT, ARK.—The Walcott Telephone Company has been incorporated with a capital stock of $5,000.

FORT THOMAS, ARIZ.—The Gila Valley Telephone Company has decided to commence immediately the construction of a telephone line to Fort Thomas.

DENVER, COL.—At the regular annual meeting of the stockholders and board of directors of the Colorado Telephone Company the following officers were elected: President and general manager, E. B. Field; vice-president, Alonzo Burt; treasurer, Edw. B. Field, Jr.; secretary and auditor, H. W. Bellard. At the meeting of the Board of Directors it was voted to expend $1,000,000 for the extension and improvement of the plant throughout the state during 1903, and the president was authorized to offer to the stockholders for this purpose $1,000,000 in treasury stock.

TITUSVILLE, FLA.—The Indian River Telephone Company has been incorporated with a capital stock of $5,000, by W. H. Harris, H. Jennings, Geo. E. Coon and others.

MOULTRIE, GA.—The war between the Moultrie Telephone Company and the Bell Telephone Company has been brought to a settlement by which the local company will install Bell instruments if so required by the subscriber.

MOUNT CARMEL, ILL.—The Mount Carmel Telephone Company, capital $7,000, has been incorporated by H. J. Leach, C. W. Leach and John Coleman.

PROPHETSTOWN, ILL.—The Whiteside Farmers' Mutual Telephone Company, of Prophetstown, has been incorporated; capital, $10,000. Incorporators: W. E. Reynolds, J. H. Mosher and Millard F. Hill.

CHICAGO, ILL.—The City Council has granted a permit to the Illinois Telephone & Telegraph Company to make underground connections from its tunnels to various downtown buildings. The company's officers say they will have 10,000 telephones in operation in the downtown district by July 1.

NEW CASTLE, IND.—Extensive improvements have been decided upon by both telephone companies operating in this city.

LOOGOOTEE, IND.—The Central Telephone Exchange building in this city was completely destroyed by fire on Feb. 20.

KNIGHTSTOWN, IND.—The Knightstown Six Mile Telephone Company has incorporated, capital $200. I. White and Chas. Mattix are the principal officers.

GREENTOWN, IND.—John C. McCabe, of Huntington, has bought the independent telephone exchange of this city and will make extensive improvements at once.

CASTLETON, IND.—The Castleton Telephone Company, of this city, has incorporated with a capital of $2,000. C. S. Irwin is president and William Herrin, secretary.

GREENFIELD, IND.—The Hannah and Jackson Telephone Company has been incorporated. The capital stock is $10,000. Coleman Pope and John W. Jackson are officers.

CLAY CITY, IND.—The Harrison Township Telephone Company has incorporated. Capital stock $5,000. J. H. Horton, John Willen and E. R. Oberholzer are the incorporators.

WILKINSON, IND.—The Farmers' Co-operative Telephone Company, of Wilkinson, has incorporated with a capital stock of $10,000. Samuel M. Overman is president and B. H. Cook, secretary.

INDIANAPOLIS, IND.—The Home Telephone Company, of Hancock County, has filed articles of incorporation. John A. Anderson, O. L. McGee and W. D. Wilbert, Greenfield, Ind., are directors.

MILLERSBURG, IND.—The Farmers' Mutual Telephone Company has removed its exchange from Clinton Township to this place, and R. J. Davenport has succeeded to the presidency. The plant will be enlarged and improved.

INDIANAPOLIS, IND.—The Winona Telephone Company, of Knox, has filed incorporation papers. The company is capitalized at $30,000. The directors are Samuel Tomlinson, A. B. Diggs, W. S. Daniels, R. A. and S. A. Tomlinson.

BLOOMFIELD, IND.—The directors of the Home Telephone Company have been working toward a reorganization. The idea is to enlarge the system. The plan is to reincorporate with a capital stock of $100,000. John F. Slinkard and John Davidson are effecting the reorganization.

EVANSVILLE, IND.—Representatives of five or more construction companies are here making plans and estimates of the proposed municipal telephone system. Mayor Covert expects to be ready to advertise for bids in a short time. Only $16,000 remains to be subscribed when a franchise will be granted by the Board of Public Works.

INDIANAPOLIS, IND.—A large number of telephone men, headed by Hon. Hugh Dougherty, of Bluffton, appeared before the legislative telephone committee a few days ago, and urged the killing of the bill requiring telephone companies to connect their switchboards in towns where two or more companies are operating and furnish service over each other's lines. They argued that the bill would work the greatest hardship on them while it would do but little good for the people of the State.

WARSAW, IND.—An attempt was made on Feb. 16 to wreck the toll cable lines and blow up the office of the Commercial Telephone Company at this place. Dynamite was inserted near the top of a pole where the cables lead into the company's office. The explosion shattered the windows of all the surrounding buildings. The upper part of the pole was smashed but the cables were damaged but little. The telephone system is owned by Strauss Brothers, of Ligonier.

NEW ALBANY, IND.—A bitter war has been declared against the Cumberland Telephone Company by the union labor organization and its sympathizers. The linemen for the Cumberland, the Home and the United Gas and Electric Company struck for more wages. The latter two companies acceded to the demands, but the Cumberland, it is said, refused to make any sort of settlement. Many sympathizers have had their telephones taken out, the city council has ordered the instruments out of the police stations and fire houses, and the county commissioners revoked the line franchise of the company giving it the privilege to use the public highways. Unless a settlement is effected litigation will grow out of the acts of the commissioners.

OCHEYEDAN, IA.—A franchise for a telephone exchange was voted by the people.

BIDWELL, IA.—The Bidwell Telephone Company has been formed and will build a line to Blakesburg.

GARRISON, IA.—The Garrison Mutual Telephone Company has been incorporated, with a capital stock of $10,000, by James Grayson and others.

WATERLOO, IA.—The Commonwealth Telephone Company, of this city, has been incorporated, with a capital stock of $900,000, by H. C. Wood and others.

IOWA CITY, IA.—The Johnson County Telephone Company's line in this city has been sold to C. H. Brown, of Grinnell. The company will be reorganized as the Iowa City Telephone Company, and will be capitalized at $100,000.

RED OAK, IA.—At a recent meeting of the Red Oak, Climax and Coburg Telephone Company these officers were elected for the ensuing year: Lloyd Cole, president; Henry Bruce, vice-president; John McGreer, secretary; Edward Cole, treasurer; Thomas Birbeck, manager.

CUMBERLAND, MD.—The Western Maryland & Hyndman Telephone Company has been organized by De Warren H. Reynolds, U. G. Carl and G. W. Randall, of Cumberland, and B. F. Madore, of Bedford. Mr. Reynolds is president and Mr. Carl, secretary.

POCOMOKE CITY, MD.—The stockholders of the Pocomoke Telephone Company elected directors as follows: J. H. Merrill, president; E. James Tull, vice-president; W. H. Walters, secretary and treasurer; E. G. Polk, W. S. Schoolfield, A. E. Tull, J. Shiles Crockett, R. J. Lambden, Joseph S. Clogg, John W. Ennis and Jas. P. Blaine.

CONCORD, MICH.—It is proposed to reorganize the Concord Telephone Company into a mutual concern.

JACKSON, MICH.—The Citizens' Telephone Company, of Jackson, now has 1,400 telephones in operation and is installing new instruments at the rate of ten a day.

BENZONIA, MICH.—The capital stock of the Benzie County Telephone Company will be increased to $50,000. The company paid an 8 per cent. dividend for the year 1902. The officers elected for the coming year are: President, W. A. Young; secretary and treasurer, H. B. Woodward.

HOKAH, MINN.—The Union Valley Telephone Company has been formed to build rural lines.

NORSELAND, MINN.—The Nicollet County Telephone Company will extend its lines from Lafayette to Gibbon.

WESTBROOK, MINN.—The Southwestern Minnesota Telephone Company, of Pipestone, Minn., will establish a local exchange here and rural lines.

BLOOMING PRAIRIE, MINN.—The Steele County Telephone Company will extend its lines to Geneva, Ellendale, Hayfield, Waltham and other points.

JOPLIN, MO.—An independent telephone line is to be built, at a cost of $15,000, connecting Joplin with Kansas City. The Home Telephone Company, of this city, and an independent company in Kansas City are backing the enterprise.

GRAND ISLAND, NEB.—The Home Telephone Company seeks a franchise for a local exchange.

DANVILLE, NEB.—The Danville Mutual Telephone Company has incorporated with $5,000 capital.

OMAHA, NEB.—The Green Center Mutual Telephone Company, of Iowa County, has been incorporated with a capital stock of $2,000 by S. D. Miller and others.

DEMING, N. MEX.—The Luna County Telephone Company, of Deming, has been incorporated; capital, $3,000. Incorporators: C. B. Bosworth, S. Lindauer, J. J. Jeffers, C. F. Reynolds and W. H. Greer.

GLOVERSVILLE, N. Y.—Fire a few days ago destroyed the building occupied by the Glen Telephone Company in Johnstown. The loss is between $15,000 and $20,000, which is practically covered by insurance.

ALEXANDRIA BAY, N. Y.—The Alexandria Bay Telephone Company, of Alexandria Bay, has been incorporated; capital, $2,000. The directors are: A. C. Cornwall, J. F. Fuller and G. L. Olds, of Alexandria Bay.

ALBANY, N. Y.—The West Shore Home Telephone Company, of Catskill, has been incorporated, to operate in Ulster, Greene and Albany counties; capital, $100,000. Directors—S. R. Rawson and T. M. Brush, Elyria, Ohio, and Howard Hendrickson, of Albany.

NEW YORK, N. Y.—A new telephone building, to cost about $70,000, is to be built for the Greenpoint branch of the New York and New Jersey Telephone Company, in Greenpoint, in a short time. The Greenpoint central office serves Williamsburg, Greenpoint and Long Island City.

RIVERHEAD, L. I., N. Y.—The Baiting Hollow & Roanoke Telephone Co. is to extend its lines to Mattituck. The line will also be extended to South Jamesport and may possibly go to Greenport. This company was organized a few years ago by a few farmers to connect their homes with a railroad station. It has since grown rapidly and has proved one of the best things that the farmers ever thought of as a money saver and aid in farming.

TOWER CITY, N. D.—Priewe & Dalrymple contemplate building a telephone line to Page.

LITCHVILLE, N. D.—The Valley City Telephone Company may extend a line to this place and put in a local exchange.

CELINA, OHIO.—The Celina and Mercer County Telephone Company, of Celina, capital stock $80,000, has been incorporated.

ST. MARY'S, OHIO.—The St. Mary's Telephone Company will rebuild its system during the coming summer. Manager J. R. Longworth is securing estimates.

BRADFORD, OHIO.—The Bradford Telephone Company has been incorporated, with a capital stock of $20,000, by Z. T. Myers, J. B. Miller, Stephen Day, W. Day and W. E. Williams.

KIDRON, OHIO.—The Kidron Telephone Company has been incorporated, with a capital stock of $15,000, by Valentine M. Gerber, Jacob P. Sommer, Elias Gerber, J. F. Armstrutz and John J. Bixler.

CLEVELAND, OHIO.—The Independent Telephone Traffic Company, of this city, has been incorporated, with a capital stock of $10,000, by Jerome Penn, Carl C. Curtis, Frank L. Beam, H. H. Robinson, G. P. Thorpe, W. G. Thompson and S. S. Henkle.

LEWISTON, PA.—The United Telephone & Telegraph Company will expend $250,000 in extensions and improvements.

PHILADELPHIA, PA.—The stockholders of the Bell Telephone Company have re-elected President James E. Mitchell and Winfield S. Piersol secretary and treasurer, and the entire present board of directors.

PITTSBURG, PA.—The Union Telephone & Telegraph Company will be incorporated with a capital stock of $3,000,000. It will make traffic arrangements with many of the independent companies in western Pennsylvania.

YORK, PA.—The York Eastern Telephone Company, capital $8,000, has been incorporated. The directors are: A. M. Grove, of Muddy Creek Forks; W. H. McCall and John H. Wilson, of Gatchelville; Henry S. Merryman and Benjamin F. Norris, of Fawn Grove; Joseph A. Gailey, of New Park, and Calvin M. Shaw, of Stewartstown.

PITTSBURG, PA.—The Central District Printing & Telegraph Company, of Pittsburg, Pa., has increased its capital stock $1,250,000, thus making the total capitalization $10,000,000. The funds thus realized will be expended in additions and improvements to the service and plant. The company proposes to erect an addition to its building on Seventh Ave., for which $171,000 of the new funds has been set aside. New buildings will also be erected in East Liverpool and Newcastle. The company now has a total of 46,859 stations and sub-stations. The officers elected for the ensuing year were D. Leet Wilson, president; D. F. Henry, vice-president; F. M. Stephenson, treasurer; George L. Herron, assistant treasurer; J. G. Stoaked, secretary and purchasing agent, and M. H. Buehler, general manager.

NEWBERRY, S. C.—It is reported that J. A. Blackwelder is interested in a proposed independent telephone company at Newberry.

VERMILLION, S. D.—A company has been formed in Norway township to build a telephone line to this city.

CANISTOTA, S. D.—J. J. McKinnon and R. H. Armstrong propose to install a local telephone exchange.

NASHVILLE, TENN.—The Tennessee Telephone & Telegraph Company has applied for a franchise in this city. It is stated that Mr. Harvey Myers, of Covington, Ky., is interested in the new company.

MEMPHIS, TENN.—The Southwestern Telephone and Telegraph Company is constructing the following new lines in Arkansas. Bridge Junction, at Memphis, Tenn., to Hoxie, 85 miles; Walnut Ridge, to Newport, 30 miles; and Jonesboro, to Paragould, 20 miles. The company's purpose is to extend the system over the entire State. Exchanges have recently been completed at Atkins, Plumeville, Cabin Creek, Coal Hill, Mulberry and a number of other places. The company now has over 5,000 miles of long distance lines in the State of Arkansas.

AUSTIN, TEX.—The Texas Telephone Company, of Wichita Falls, has been incorporated with a capital stock of $48,000. The incorporators are J. J. Lory, C. B. Felder, A. Zundelowitz, A. H. Carrington and J. H. Hardin.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has added over 300 telephones to its service in Salt Lake City during the past two months.

ROANOKE, VA.—It is now said to be settled that the Southern Bell Telephone Company, which operates an exchange in this city, with long-distance connections, will absorb the Virginia and Tennessee Telephone Company.

ONANCOCK, VA.—The Diamond State Telephone Company, of Delaware, will spend $150,000 in betterments. The company recently bought out the Atlantic Telephone Company and the Onancock Telephone Company, and it is understood that it will soon come into possession of the Peninsula Telephone Company, which operates about 175 telephones.

LA CROSSE, WIS.—The Vought-Berger Co. will enlarge its telephone factory.

WAUSAUKEE, WIS.—The Wausaukee Telephone Company will extend its line from Ellis Junction and Crivitz to Pembine.

ROCHESTER, WIS.—The Burlington, Rochester & Kansasville Telephone Company, of Rochester, has been incorporated; capital stock, $2,500. Incorporators, George W. Rountree, Brook Sheard and George W. Waller.

FOND DU LAC, WIS.—F. H. Sweet, receiver for the Little Wolf River Telephone Company, has entered an application in Circuit Court for an order to sell the company's property at public auction. The sale will probably take place within a few weeks. The Wisconsin Telephone Company will probably be a bidder. The stockholders in the original Little Wolf Company, however, are anxious to reorganize the company and are making every effort to raise the necessary funds.

VANCOUVER, B. C.—The New Westminster & Burrard Inlet Telephone Company, of this city, has arranged to lay a cable across the Gulf of Georgia connecting Vancouver and Victoria. The estimated cost is $170,000.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—The Birmingham District Coal & Light & Power Co. has been incorporated, with a capital of $100,000, by T. H. Aldrich, Jr., and V. Spear. The company proposes opening the mines and building an electric plant at the mines for supplying electric power and lighting in Birmingham and vicinity.

CALHOUN, GA.—J. T. Black is soliciting stock for a company proposing to erect a $11,500 electric light and power plant near Calhoun.

ATLANTA, GA.—The International Steam Engineering Company, of Atlanta, has made a bid to erect a plant for municipal lighting at a saving of $83,000 annually in the cost of lights.

CARTERSVILLE, GA.—Michigan and Chicago capitalists are considering the utilizing of the power of the Etowah River near Cartersville. It is estimated that 17,000 horse power is available.

DENVER, COLO.—The New Century Light & Power Company has been formed, to supply power to manufacturing plants in Denver and also towns and cities of this state. The site of the reservoir and power plant is near Kremmling. The probable cost of the work is $6,000,000. R. G. Munn is President and Fred W. Hart Chief Engineer.

BYRON, ILL.—John Whitaker is reported interested in the construction of an electric light plant.

EAST PEORIA, ILL.—It is stated that the East Peoria Heat, Light & Power Company is to construct a plant, to cost about $50,000.

CANNELLON, IND.—The city council has bought the local electric lighting plant and will make it a municipal affair.

MARION, IND.—The Citizens Electric Light Company, of this city, has organized and incorporated with $50,000 capital. The company will construct a modern plant and will compete with the Marion Light & Heat Company.

LAFAYETTE, IND.—The Wabash Oil & Gas Company, in connection with Lafayette and Chicago capitalists, will, it is reported, soon begin to construct dams and a $250,000 electric light plant at Horseshoe Bend on Tippecanoe River.

SYRACUSE, IND.—The Syracuse Power, Light & Manufacturing Company has incorporated with a capital of $60,000. The company will construct a dam in Elkhart river to generate electric power. J. P. Dolan, of Syracuse, is secretary of the company.

RICHMOND, IND.—Application has been made by a company which desires to buy the municipal electric light plant. The citizens are divided on the advisability of selling, one faction insistng on a sale because the muncipal plant is running behind each month; the other faction opposes the sale because the plant has been running only a few months and not had a fair municipal test.

DUBUQUE, IA.—The Union Electric Company will erect a new station building and install a complete power plant, including two 2300-volt 3-phase alternating direct-connected units, each of 500-kw capacity, and two direct-current railway units of the same capacity.

BOWLING GREEN, KY.—The City Council has authorized the establishment of an incandescent service in connection with its arc light system.

ST. FRANCISVILLE, LA.—P. H. Porter, of Clinton, Ky., has secured the contract for constructing the municipal electric light plant for $6,300.

NORTH ANSON, ME.—Lockwood, Greene & Co., Boston, Mass., have been employed by W. A. Bailey, of North Anson, to develop a water power on the Carrabassett River to serve manufacturing interests at that point.

PORTLAND, ME.—The United States Light & Traction Company has been organized at Portland, with $100,000 capital stock. The officers are: President, H. P. Sweetsir, of Portland; treasurer, Edward W. Guptil, of Portland.

STANDISH, MICH.—The House has passed the bill to authorize this village to issue bonds for the purchase or construction of an electric light plant.

CHINOOK, MONT.—Attorney J. N. Booth, of Great Falls, has petitioned the City Council of Chinook for a franchise for an electric light and power plant.

FREMONT, NEB.—L. D. Richards and Fred W. Vaughan have petitioned the City Council for a franchise to install a subway and conduit system in Fremont.

LITTLETON, N. H.—The Littleton Light & Power Company will equip a complete steam plant at the lower electric light station. The contracts for equipment have all been placed.

TRENTON, N. J.—The General Light, Power & Pump Company has been incorporated; capital, $300,000. Incorporators—Charles King, S. C. Woodhull and C. F. Woodhull.

SARATOGA, N. Y.—The Hudson River Water Power Company, of Saratoga Springs, has increased its capital from $2,000,000 to $5,000,000.

COHOES, N. Y.—The Hudson River Electric Light Co. has petitioned the Council for a franchise to furnish heat, light and power in Cohoes.

OXFORD, N. C.—Oxford will issue $25,000 bonds for an electric light plant and water works.

HIGH POINT, N. C.—The Senate has passed on second reading the bill to allow this city to issue $90,000 for electric lights, etc.

TOLEDO, OHIO.—The Lucas county commissioners are planning to establish a lighting plant to supply light for all the county buildings in Toledo. J. M. Osgood is securing estimates.

SCHOOLCRAFT, OHIO.—A special election will be held March 9 to vote on a proposition to issue $11,500 in bonds for the purpose of building an electric light system.

FINDLAY, OHIO.—The City Light, Heat & Power Company has organized with E. Wanamaker, president; F. J. Pogue, vice-president; W. V. Coons, secretary-treasurer; J. Bash, A. L. Davis, J. E. Bicknell and T. H. McConica directors. The company will establish a plant and will make a bid for the city lighting contract which is now held by the Toledo, Bowling Green & Southern Traction Company.

PERKASIE, PA.—The citizens have voted to expend $8,000 for a duplicate electric light plant.

SHENANDOAH, PA.—The Town Council has granted the People's Artificial Light Co., of Shenandoah, an electric light franchise.

STROUDSBURG, PA.—The Munroe County Water, Power & Supply Company, capital stock $10,000, has been incorporated. Treasurer, W. S. Shafer, Stroudsburg. Directors—W. S. Shafer, Van C. Peters, N. H. Shafer, J. H. Shull, S. E. Shull, Stroudsburg.

BEAUMONT, TEX.—Hal. W. Greer, Walter J. Crawford and others have petitioned the Council for a franchise for an electric light and power plant.

ROCK ISLAND, TENN.—It is reported that Philadelphia capitalists will probably invest $1,000,000 in developing the falls of Caney Fork near Rock Island, in White County, Tenn., near the point where the Great Falls Power Company will soon begin a similar undertaking. Eight thousand two hundred and fifty horse power are said to be available. The company will probably offer the power developed to the neighborhood.

SALT LAKE CITY, UTAH.—Plans for the Mackay Idaho Light & Power Company's dam and ditch, which are to cost $125,000, are now being made. The dam is to be built at the head of the narrows above the town where the fall of the water is 100 feet. The plant will generate 3,000 horse power for the development of electric current which will be used to light the town, in the smelter, and for operating the electric road.

LYNCHBURG, VA.—The Lynchburg Water Power Company has let the contract to Geo. O. Tenny, of Spartansburg, S. C., for the building a dam across the James River. The power will be used for operating the electric railways and lighting the city. The work will cost over $100,000.

READSBORO, VT.—W. D. Howe, of Readsboro, and E. W. Kelly, of Providence, R. I., are reported to be planning to build a dam in Readsboro to generate electric power to be transmitted throughout upper Deerfield Valley and to North Adams, Mass.

KALAMA, WASH.—Atkins & Watson, it is stated, have secured a franchise for an electric light plant.

WATERTOWN, WIS.—It is stated that the Watertown Electric Light Company will make alterations at its two power houses and will soon install new machinery.

SHEBOYGAN, WIS.—It is stated that the Sheboygan-Elkhart Lake Railway & Electric Company is about to petition the Council for the privilege of doing an electric lighting business in this city.

EVANSTON, WYO.—Articles of incorporation have been filed by the Box Elder Power & Light Company. The headquarters of the company are at Evanston. The capital stock is $100,000.

BERLIN, ONT.—A vote on the by-law for $100,000 to take over the gas and electric light plant resulted favorably. The town took possession on March 1.

THE ELECTRIC RAILWAY.

HARRISON, ARK.—The Arkansas Traction Company has been incorporated with a capital stock of $500,000. The charter permits the company to generate electricity for commercial purposes. The officers are Thomas Helm, of Harrison, president; R. M. Fellows, of Harrison, secretary and treasurer; C. Irving Page, of Rochester, N. Y., vice-president.

MONTEREY, CAL.—R. C. P. Smith has secured a franchise for the construction of an electric railway in Monterey.

LOS ANGELES, CAL.—Articles of incorporation have been filed by the Bakersfield & Ventura Railway Company, capitalized at $1,000,000. The directors are Eben Smith, J. W. Burson and Gervalse Purcell, of Los Angeles.

LOS ANGELES, CAL.—The Kern River Power Company, of Los Angeles, Cal., has recently purchased from the Westinghouse Electric & Manufacturing Company two compound-wound, 150-kw generators to be installed in its power house.

MONTVILLE, CONN.—The Montville Street Railway Company proposes extending its line to Oakdale.

ROCKVILLE, CONN.—The Rockville and Broad Brook Street Railway Company is about to be formed. C. E. Harwood, of Rockville, is interested.

HARTFORD, CONN.—The Meriden & Middletown Traction Company has applied for a charter. The preliminary capital of the company is to be $25,000, with the privilege of increasing to $500,000. Among the incorporators are I. E. Palmer, W. W. Wilcox, of Middletown, and Francis Atwater, of Meriden.

NEW LONDON, CONN.—The East Lyme Street Railway Company, which has secured a special charter for an electric railway from New London to East Lyme has organized with Richard C. Morris as president and treasurer, and Calvin S. Davis as secretary. The capital stock of the company is $100,000.

BRUNSWICK, GA.—A number of business men have applied for a franchise for an electric railway system.

ATLANTA, GA.—The Chattahoochee Terminal Company, of Atlanta, has been chartered by Thos. A. Gramling and others. The road will be 20 miles long. The capital stock is $250,000 to begin with.

AUGUSTA, GA.—Jas. U. Jackson, of Augusta, and others will apply for a charter for the Augusta and Columbia Electric Railway.

POCATELLO, IDAHO.—I. B. Perrine has applied for a street railway franchise.

RICHMOND, IND.—J. Morgan & Co., of Toledo, are promoting a traction line from Toledo to Richmond.

TERRE HAUTE, IND.—The Terre Haute Street Railway Company will make extensions and construct some interurban lines.

HARTFORD CITY, IND.—The Muncie, Hartford & Ft. Wayne Traction Company has made application for a lighting franchise in Hartford.

MARION, IND.—C. H. Bundy, John E. Clark and Everett W. Trook have been granted a franchise for the construction of an electric railway through Howard County.

BROWNTOWN, IND.—The name of the Greenwood interurban railway has been changed to the Indianapolis, Columbus & Southern Traction Company and the capital stock has been increased from $150,000 to $285,000.

INDIANAPOLIS, IND.—The Indianapolis & Cincinnati Traction Company, capital stock $1,500,000, has been incorporated by C. L. Henry, W. L. Taylor, T. F. Rose, Ephraim Marsh, Wm. Frazee, E. M. Johnson and J. F. Fesler.

TERRE HAUTE, IND.—The Indiana Coal Belt Traction Company has been incorporated with $100,000 capital stock by Charles L. Davis, W. H. Crowder, Ward Hawkins, W. Paul Stratto, L. A. Stewart and others, of Sullivan, Ind.

TERRE HAUTE, IND.—The city council has granted a 50-year franchise to the Terre Haute Street Railway Company for a consideration of $78,000, $16,000 cash in hand, and $16,000 annually after 1918. The company says it will now make extensions and construct some interurban lines.

DES MOINES, IA.—The Des Moines City Railway Company will spend $500,000 in improvements.

OELWEIN, IA.—The Oelwein & Northwestern Interurban & Street Railway Company has organized, with John Jamison president, and Wm. A. Reed secretary.

CEDAR RAPIDS, IA.—The City & Southern Railway Company proposes to construct an electric railway from Cedar Rapids to Iowa City, a distance of 30 miles. Estimates are now being made on electrical equipment.

MARSHALLTOWN, IA.—The Marshalltown Electric Street & Interurban Railway Company has been organized with a capital stock of $25,000. The directors of the company are H. E. Sloan, H. P. Deusel, Charles Glick, E. L. Will, George R. Estabrook, F. E. Glick and A. G. Glick, of Marshalltown.

CLINTON, IA.—A company has been organized here to build an electric railway between Clinton and Davenport, a distance of 42 miles. The capital stock of the company is $10,000 and the officers are John U. May, president; Mary Harrah, vice-president and treasurer; J. J. Melchert, secretary. The officers constitute the board of directors.

LOUISVILLE, KY.—A special meeting of stockholders of the Louisville Street Railway Company has been called for the purpose of voting on a proposition to increase the preferred stock of $2,500,000 and the common of $3,500,000, by 40 per cent. each. The company will, it is reported, make an extension to its power house.

SHREVEPORT, LA.—The Shreveport & Suburban Traction Company has been incorporated with a capital stock of $400,000. The incorporators are John R. Miller, William S. Lambert, Herman Hedberg, Austin Miller and Cecil L. Blaud.

ELKTON, MD.—The City Council has granted a franchise to the Kent & Cecil Electric Railway Company.

TOWSON, MD.—The Towson & Cockeyville Electric Railway Company is to be incorporated with a capital stock of $100,000. The incorporators will include Joshua F. Cockey, William H. Wright, E. Herman, James S. Nussear and Milton W. Offutt.

GRANBY, MASS.—It has been decided to extend the Hampshire & Worcester Street Railway from South Hadley Center to Granby.

SHELBURNE FALLS, MASS.—Herbert Newell, of Shelburne Falls, is said to be interested in the construction of an electric railway from Shelburne to Ashfield and Buckland.

NEW BEDFORD, MASS.—The Horseneck Beach Railway Company has applied to the Legislature for incorporation. The company is to be capitalized at $300,000. E. G. Gifford and C. F. Gifford, of Westport, are among those interested.

DETROIT, MICH.—The Detroit United Railway Company has placed a contract with the Westinghouse Electric & Manufacturing Company for 214 50-hp motors.

GRAND RAPIDS, MICH.—The Grand Rapids Street Railway Company has elected these officers: C. M. Clark, president; L. J. Ringe, vice-president and general manager; B. S. Hanchett, secretary-treasurer.

MUSKEGON, MICH.—The present officers of the Muskegon Traction & Lighting Company have been re-elected except J. J. Howden, who retired as vice-president in favor of Liddon Flick. One hundred thousand dollars preferred stock will be issued to retire outstanding bonds and provide funds for betterments.

MANKATO, MINN.—Herd & Keator have been granted a franchise for the construction of an interurban electric railway through the county toward St. Peter.

ST. PAUL, MINN.—A double-track trolley road from Duluth to Texas, with a capital of $70,000,000, is being projected here. Capitalists, among whom are W. D. Washburn, John W. Gates and others, are said to be interested. Application for charters in each State will be made soon.

GREENVILLE, MISS.—The Delta Electric Light, Power & Manufacturing Company is said to be in the market for the equipment for the electric railway that it proposes to build here.

GREAT FALLS, MONT.—E. E. Shepard, of Austin, Minn., is reported interested in the construction of an electric railway from Great Falls to Chocteau, a distance of 60 miles.

PATERSON, N. J.—The Paterson & State Line Traction Company has secured a franchise in Hawthorne Borough.

TRENTON, N. J.—The Philadelphia & Langhorne Street Railway Company proposes an extension over the turnpike from Somerton to Feasterville and Willow Grove.

TRENTON, N. J.—The Cuba Eastern Railroad Company has been incorporated to operate railroads or traction lines in Cuba. The authorized capital stock is $2,000,000, and the incorporators are Louis N. Wheaton, Stallo Vinton and Frederick B. Mearkles.

UTICA, N. Y.—The Utica & Mohawk Valley Railway Company may erect a new power plant.

CHENANGO FORKS, N. Y.—The Binghamton Railway Company will extend its line to Chenango Forks, Port Crane and Owego.

TRUMANSBURG, N. Y.—H. F. Bell, representing promoters of an electric railway between Ithaca, Seneca Falls and Waterloo, is about to apply for a franchise here.

FARGO, N. D.—The Fargo & Moorehead Street Railway Company is said to have contracted with the Electrical Installation Company, of Chicago, for the construction of its proposed line to connect Fargo and Moorehead.

DELAWARE, OHIO.—The Delaware, Bellefontaine, Ft. Recovery & Wabash Traction Company will be incorporated.

DAYTON, OHIO.—A party of local capitalists have about decided to introduce trackless electric street cars in this city.

NEW INDUSTRIAL COMPANIES.

THE WESTERN ELECTRIC DRILL & MACHINERY COMPANY has been incorporated at Helena, Mont.

THE PITTSBURG FINANCIAL COMPANY, of Pittsburg, has been incorporated to erect, construct, maintain and operate telephone and telegraph lines; capital, $1,000,000.

THE STAR DYNAMO BRUSH COMPANY, New York, has been incorporated; capital, $1,000. Directors: W. L. Webb, Karl Ambrock and Alexander Schilling, New York.

THE CONTRACTORS' ELECTRICAL COMPANY, New York, has been incorporated; capital, $5,000. Directors: J. S. Ross, Brooklyn; F. Kling and H. W. Redfield, New York.

THE PUEBLO ELECTRIC METALLIC EXTRACTION COMPANY, of Pueblo, Col., has been incorporated; capital stock, $100,000. Incorporators: John H. Johnson, J. W. Tanner and C. H. Dolly.

THE J. F. KELLY ENGINEERING COMPANY has been incorporated in New Jersey with a capital of $50,000. The incorporators are: Walter Fairfield, Theodore W. Kloman and George E. Griswold.

THE HUNTER ELECTRIC ADVERTISING SIGN COMPANY, of Cincinnati, Ohio, has been incorporated, with $20,000 capital. The officers are: President, George B. Riley; vice-president, Samuel Cohn; secretary, John F. Ankenbauer; treasurer, James C. McWilliams.

THE SWAN ELECTRIC COMPANY has been organized at Portland, Me. The capital stock is $100,000. The promoters are: Frederick A. Swan, Saugus, Mass.; Frederick L. Fisher, Somerville, Mass.; Ernest O. Hiler, Boston; Walter A. Morgan, Llewellyn Carleton, Portland. Walter A. Morgan is president and Ernest O. Hiler treasurer.

LEGAL.

LAMP SOCKETS.—A suit has been filed by the General Electric Company against the Crouse-Hinds Company, of Syracuse, for the infringement of incandescent lamp sockets. This suit is based upon the Tournier patent No. 559,232.

LIABILITY FOR TELEGRAMS.—Justice Davy, in the special term of the Supreme Court at Rochester, N. Y., recently handed down a decision to the effect that the addressee of a telegram cannot hold a telegraph company liable for delay or failure to deliver a message; that the sender of the message is the only person that can recover under the statutes.

INDEPENDENT TELEPHONES IN LOUISVILLE.—In the case of the Cumberland Telephone Company vs. the Home Telephone Company, of Louisville, the Court of Appeals has decided that the Cumberland Company did not have the exclusive right to the streets of Louisville, and that the Home Company, although chartered in Delaware, had the right to do business in Kentucky and that the state or city government and not the Cumberland Company had the right to question in court its right to operate in the state.

TELEPHONES IN DETROIT.—The Michigan Supreme Court has handed down a decision upholding the Wayne Circuit Court in granting a mandamus to compel the Michigan Bell Company to give to John Mahan, a subscriber of the Detroit Telephone Company (which the former company absorbed) telephone service at the old Detroit Company's rate and connection with the Michigan switchboard. This, it is held, in effect fixes telephone rates in Detroit at $40 per year for business telephones and $25 per year for residences—the old Detroit rates.

BELL TELEPHONE TAX.—A bill has been passed by the Massachusetts Legislature which officially recognizes the passing of the Bell Telephone Company to New York from Boston. It appropraites $1,350 to be paid to the company to satisfy a judgment entered in the Superior Court against the Commonwealth for refund of its franchise tax for 1901. "This bill," said Commissioner of Corporations Trefry, "dates back to the transfer of the company to New York. We tried to tax some of the stock held here. The company resisted and the case was taken to court and decided."

WIRELESS SYSTEM IN HONOLULU.—A report from Honolulu, S. I., of February 18 states that the Circuit Court there has found that Marconi was not entitled to pay for the installation of his wireless telegraph system in Hawaii, and that the system in use was an improvement upon the one he had attempted to establish. The case was that of Marconi's Wireless Telegraph Company against F. J. Cross, wherein Marconi sued for $5,500, half of the purchase price of the patent, and for $2,500, one year's royalty upon the use of his system. Cross, who is a citizen of New York, alleged that the system installed by Marconi three years ago was a farce, that it did not work and that the one now in use here was an improvement upon the Marconi system and was installed by himself. He testified that Marconi had agreed to place the system in perfect operation for $11,000, that after the contract had been made the experts who came out were frightened by the plague and returned home, leaving the system useless. Then new experts were sent from South Africa by Marconi, who discovered that the failure was due to the placing of the poles in dry earth instead of near the seashore. A complete change of the system was then made, and the experts instructed a class of Hawaiian girls as operators. Then the coherers gave out and the line failed again, and Cross asserted that Marconi had not kept his contract by furnishing a duplicate set of instruments. Again the system had to be abandoned, and finally Cross gave up Marconi's idea, and went off on his own hook. He secured a duplicate set of telegraph keys, manufactured a new kind of coherers, which he says did the work much better, and also made new condensers. With the improvements made by himself, the system was a success, and has been working now satisfactorily for over six months. The jury was out only two hours in deciding that the contract had not been carried out. A verdict for the defendant was returned. An appeal was taken on behalf of Marconi by his attorneys and if necessary the case will be carried to the United States Supreme Court, as the inventor believes the stability of his patent rights is involved. The suit was brought by Marconi's Wireless Telegraph and Signal Company, the English corporation which has control of all the patents.

OBITUARY.

F. L. HOMER, president and treasurer of the Homer Commutator Company, Cleveland, Ohio, died recently. The business will be continued under the old name.

MR. A. M. PENNOCK.—Mr. Allen M. Pennock, who was connected with the electrical department of the Western Union Telegraph Company for several years, died of pneumonia last week in Brooklyn, at the age of forty-five years. He was a native of Bordentown, N. J.

PERSONAL.

MR. T. A. EDISON and family are making their usual winter trip to Florida, where he has a plantation.

MR. EDWIN HAWLEY has been elected a director in the Postal-Telegraph Cable Company to succeed the late Mr. John W. Mackay.

COL. GEO. W. DUNN, of Binghamton, has been elected Chairman of the State Railroad Commission, vice Ashley W. Cole, retired.

MR. A. N. NIELSEN, the assistant treasurer of the Kings County Electric Light & Power Company, of Brooklyn, has been promoted to the treasurership.

MR. S. S. SUMMERS, consulting engineer of the Denver, Colo., electric traction system was in New York last week securing figures for equipment, etc., to be installed in the extensive power house addition.

MR. JOSEPH E. LOCKWOOD, president of the Michigan Electric Company, of Detroit, was in New York City the past week as a participant in the municipal ownership convention, on the part of Mayor Maybury.

MR. EDWARD A. LESLIE has been elected second vice-president of the Kings County Electric Light & Power Company, of Brooklyn, which controls the Brooklyn Edison system, of which he has been manager for some time past. The office is a new one.

MR. W. J. FLANNERY, recently with the Western Electric Company in New York and formerly with the Stanley Instrument Company, has accepted the position of sales manager with the Electrical Material Company of Baltimore.

MR. LUTHER STIERINGER, who has been traveling for his health in the extreme Southwestern States for some time past has reached California and reports from the Edison stronghold at Los Angeles as well as other electrical centres in the State.

MR. GEO. F. GREENWOOD, general manager and chief engineer of the Havana Electric Railway Company, whose proposed extension is referred to elsewhere in this issue, has been in New York since the beginning of the week. He returns to Cuba Saturday.

MR. JOHN A. ABBOTT has resigned as vice-president and general manager of the Consolidated Railway Lighting & Refrigerator Company. He has also dissolved his connections with the subsidiary companies, including the Consolidated Lighting & Equipment Company.

MR. S. S. BOGART.—At a meeting of the board of directors, Mr. S. S. Bogart, for sixteen years identified with the Western Union Telegraph Company, and formerly superintendent of that company, has been elected a director of the American De Forest Wireless Telegraph Company.

MESSRS. DODGE & DAY, the modernizing engineers of Philadelphia, have been commissioned by the Ingersoll-Sergeant Drill Company to report on variable speed motor equipment for the new Phillipsburg plant, and have been awarded the contract to equip with motor drives a number of the large machine tools.

PROF. JOHN E. SWEET, of Cornell University, lectured before the Automobile Club of America at the clubhouse, New York City, last week, on "Steam as a Motive Power for Automobiles," and described in detail the results of his experiments in devising a steam engine for use in motor vehicles. It cannot be said that great enthusiasm as to steam automobiles marked the occasion.

HENRY NOYES, of the Australasian electrical engineering and contracting firm of Noyes Brothers, Sydney, N. S. W., which represents the interests in that part of the world of Westinghouse, Church, Kerr & Company, J. G. Brill Company, etc., is now in New York. He is at the Waldorf-Astoria. Downtown he may be found at the Westinghouse offices, Maritime Building.

MR. CHARLES M. SCHWAB, the president of the U. S. Steel Company, in a recent interview said: "There's too great a tendency toward what is called 'gentle callings' or 'learned professions.' We need physicians and lawyers, but not so many. The youth who is a practical electrician can earn twice as much as the average doctor or lawyer."

MR. WALTER G. CLARK, of the firm of Kilbourne & Clark, Seattle, Wash., has been a visitor to New York City during the past few weeks. Among the large number of agencies handled by this firm is that which it recently secured for the Nernst lamps, embracing representation on the entire Pacific Coast. Mr. Clark speaks in glowing terms of the immense electrical development in the Northwest, in which, incidentally, his firm has had no little part.

MR. HENRY HALSEY, a young lawyer, is reported by the *New York Herald* to be working on the uphill job of perfecting a primary battery for automobile work. "Stripped of technicalities, the lawyer's battery is nothing more than an ordinary battery, in which the carbon disk is made to revolve in the sulphuric acid and water. The zinc plates are, as in the common batteries, stationary. From the disc the element of power is taken by brushes against which it revolves. These connect with posts through which wires are passed leading to the motor. Contradictory as it may appear, the motor run by the battery in turn revolves the disks by which the sustaining power is furnished."

MR. CHARLES S. POWELL, who has been associated with the Westinghouse electric interests since 1893, and who, for the past six years, has been manager of the Cleveland office of the Westinghouse Electric & Manufacturing Company, has changed the scene of his activities from the United States to Europe. He has been appointed assistant manager of the British Westinghouse Electric & Manufacturing Company, Limited, and has already entered upon the duties of his new position. Mr. Powell, who is one of the most popular men in the electrical business in the United States, is sure to be equally well liked in Great Britain. His headquarters will be in the Westinghouse Building, Norfolk Street, London, W. C.

THE JOHN F. KELLY ENGINEERING COMPANY.—Mr. John F. Kelly, who needs no introduction to the electrical public, has associated with him Mr. T. W. Kloman and Mr. W. L. Fairchild for the conduct of a consulting and contracting engineering business, under the firm name of The John F. Kelly Engineering Company, Incorporated. Mr. Kelly is president and consulting engineer of the company, Mr. Fairchild, vice-president and secretary, and Mr. Kloman, treasurer and manager. Like Mr. Kelly, Messrs. Fairchild and Kloman have been prominently identified for years with the Stanley Electric Mfg. Co., the latter more recently as manager of the New York office and Mr. Fairchild as sales engineer. The new firm starts out with considerable transmission work in the West and in Mexico, and is understood to have strong financial support for any large projects it may undertake. Mr. Kelly, who will remain consulting engineer of the Stanley Instrument Company, has won his spurs in every department of electrical engineering, and since the development of electric power transmission has been a potent factor in that field, as the success of the several great installations he has planned abundantly testifies. As both Mr. Fairchild and Mr. Kloman unite strong business capacity with engineering knowledge, the combination is one which meets the conditions of the day, and a successful future for the new company can safely be predicted.

Trade Notes.

OIL FILTERS FOR FOREIGN COUNTRIES.—The Burt Mfg. Co., of Akron, Ohio, has made a shipment of oil filters to Sydney, Australia, and one of five filters to Stockholm, Sweden, also five to Johannesburg, South Africa.

THE BABCOCK & WILCOX COMPANY is issuing to the trade copies of the decree and injunction secured by it from the U. S. Circuit Court, Southern District of New York, protecting it against infringement of the trade name of its famous water-tube boilers, whether the full name or such abbreviations as "B. & W."

MESSRS. W. M. SHEEHAN & CO., 136 Liberty St., New York, are meeting with a large demand at present for Nernst lamps. A test made by this firm showed by wattmeter readings, that a 50-cp Nernst lamp consumes 92 watts while a 50-cp standard incandescent lamp consumes 155 watts. This certainly shows economy.

DAYTON FANS.—The Dayton Fan & Motor Company, Dayton, Ohio, has this year revived its original type of Dayton fan, which was once very popular and bids to become so again. Otherwise its product for 1903 will be practically the same as that of last year. The company has taken its license under the ceiling-fan patents of the Diehl Company.

THE HOMER COMMUTATOR COMPANY, Cleveland, Ohio, at a recent meeting elected the following named officers: President, John H. Simpson (vice F. L. Homer, deceased); J. C. Kraus, vice-president, and Fred J. Baird, secretary and treasurer. The business has grown so rapidly that it will soon be necessary to build an addition to the factory.

THE AMERICAN ELECTRICAL SUPPLY COMPANY, of Baltimore, has moved its offices and manufacturing plant to No. 10 E. Pratt Street. It is now in possession of increased facilities for manufacturing its line of porcelain specialties, which includes combination fuseless rosette moulding and cleats, wall receptacles, fuseless rosettes, receptacles and sockets, sign receptacles, main and branch cut-outs, plug cut-outs and fusible attachment plugs.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Fostoria, Ohio, informs us that it has received the contract to furnish the entire supply of train lighting and standard lamps for the New York Central & Hudson River Railroad Company, for all its leased and operated lines. Fostoria lamps have been used in the New York Central's train lighting service for about four months and they have been found so satisfactory that the contract above referred to was the result.

THE HUGHES TELEPHONE MANUFACTURING COMPANY, Baltimore, Md., has recently located offices at 123 Hanover Street, in connection with its new manufacturing plant. This company makes a specialty of manufacturing and installing complete telephone systems for hotels, apartment houses, public buildings, etc. These systems are both of the intercommunicating type and for use in connection with switchboards. Its new plant gives it superior facilities for turning out high-grade work promptly.

THE OTIS ELEVATOR COMPANY has been awarded the John Scott Legacy Medal and Premium by the Franklin Institute for its electric elevator for private residences, which dispenses with the services of an attendant and is operated by merely pushing buttons at the various landings and in the car. The Committee on Science and the Arts, which recommended the award, made a thorough inspection of several existing installations and their report is highly commendatory of the ingenuity of design, the safety of operation and the substantial construction.

BELTS FREE.—The offer of Graton & Knight Manufacturing Company, Worcester, Mass., to send, free of charge, one of its superior oak tanned belts to any manufacturer who would like to test it, is attracting a good deal of attention. The reputation of this old house is a guarantee of the excellence of its belting, and that it will in every minutest respect do exactly as they agree. Any of our readers who are interested in securing the best of belting at the lowest possible cost should write immediately to the Graton & Knight Manufacturing Company, and ascertain further details.

THE COLD WAVE ACCOUNTED FOR.—The well-known business establishment of Messrs. E. B. Latham & Co., 39 Vesey Street, New York, believes that they unintentionally created a very unpleasant state of affairs throughout this country on February 17. The cause of this was several large shipments of Tuerk alternating current ceiling fans made to all points of the compass simultaneously. The ability of the fans to "raise the wind" in hot climates is universally conceded, and Mr. Latham desires to apologize for his thoughtlessness in moving so large a number of the fans at this season of the year, when the supply of coal to neutralize the effect is limited.

THE ROBBINS & MYERS CO., Springfield, Ohio, will take extra care of its fan trade this year, and will do its best to keep as many of the 76,000,000 inhabitants of this country as cool as possible during the Summer. Last year's types of fan will be reproduced this year, which fact may be taken to indicate that there is little room left for improvement in its goods. Its fans, both the ceiling and desk types, are favorably known in the trade, the highest skill in science and industry being represented in their design and production. The company is bringing out this year, as already noted, a 500-volt ceiling fan which consumes .2 ampere of current, running at a speed of 200 r.p.m. This fan is provided with extra heavy insulation to withstand the high pressure.

CONDUIT COMMENTS.—Under this title a handsome advance circular has been recently issued by the Standard Vitrified Conduit Company, 39 Cortlandt Street, New York. It gives some well-condensed information on this type of conduit, which is made single and multiple, of vitrified clay, salt glazed, and possesses some advantages which cannot fail to interest all who use underground conduits. The company also manufactures third-rail insulators, of which make 60,000 have been delivered to the Manhattan Railway Company, New York. The company's factories have an annual capacity of 25,000,000 feet of conduit. The company installs conduit systems complete. All persons interested can obtain a copy of the company's new illustrated catalogue on application.

EMERSON FAN MOTORS.—This year's styles of fan motors and ceiling fans for alternating current manufactured by the Emerson Electric Manufacturing Company, St. Louis, Mo., are described and illustrated in an excellent manner in a handsome 80-page catalogue recently issued by the company. A list of types and sizes shows that there are 29 different sizes of desk, bracket, ceiling and exhaust fans for high and low frequency; column fans for low frequency and direct-current exhaust fans. The catalogue contains 23 illustrations of as many different styles of fans, and three other illustrations showing, by means of section views, the constructional details of these well-known machines. The text is brief, but very comprehensive, a code accompanying the description of each style. The catalogue has an attractive cover, and is printed very tastefully.

NERNST LAMPS.—One of the highest tributes given to the Nernst Lamp is the fact that the Frick Building, in Pittsburg, although fitted with a complete power plant of its own, has at considerable cost contracted wih the Allegheny County Light Company for alternating current solely to make the use of the Nernst lamp possible. The corridors, and bankers' and brokers' offices on the first floor are lighted by six-glower lamps of the Nernst patent, which very satisfactorily answer the difficult proposition involved in illuminating apartments with very high ceilings. The draughting rooms of the Engineering Department, Pennsylvania Railroad, in the Union Station, Pittsburg, have also recently been fitted throughout with the Nernst Lamp. The quality of this illuminant is peculiarly suited to the requirements of draughtsmen, having a perfect downward distribution of light of daylight quality, with an absence of shadow or flicker.

CALCULAGRAPH SERVICE.—The Calculagraph Company, of 9-13 Maiden Lane, New York, states that in October, 1902, sixteen calculagraphs were purchased by a telephone company and installed, one each, in sixteen different exchanges. The records of toll messages made by those sixteen calculagraphs during the month of November were analyzed for comparison with manual records made in the same sixteen exchanges during a previous month. It was found that while 1,663 fewer toll messages were sent in November, the receipts

were larger than during the previous month, and the number of "excess minutes" was increased from 6,929 to 22,846, or 15,917 more "excess minutes" were shown on the Calculagraph records than on those made with a pencil. The value of those 15,917 toll minutes was $1,126.20, which represents the net earnings of the sixteen Calculagraphs for one month, or an average of $70,39 for each instrument. This result was so satisfactory to the officials of that telephone company that it has since placed an order for 138 calculagraphs, for use in other exchanges in its territory.

"WOOD" FAN MOTORS.—The Fort Wayne Electric Works, Fort Wayne, Ind., has recently issued its 1903 fan motor catalogue, which illustrates and describes the various styles of fan motors which they are introducing this year. These fan motors are manufactured for both direct and alternating current. They are also made in two distinct types—the revolving and the desk type. The revolving type is very unique and is said to be different from anything that has heretofore been placed on the market. The desk type operates an 8-inch fan, which gives just sufficient and not too much of a breeze. Attention is particularly called to the very small amount of energy required to operate these motors. Some central stations might object to this, but against this objection is set the argument that a great many more fans will be used by certain customers and also that a great many more consumers of electrical energy will use fans simply because the fan motor is so efficient, which would practically make an even thing of it, so far as the consumption of energy is concerned. Furthermore, it is a load that is thrown upon the station at a time when the machinery is more able to handle it.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 24, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

721,147. OVERHEAD TROLLEY; J. E. Byers, Butler, Pa. App. filed April 11, 1902. A device for retaining the trolley on the wire.

721,161. ELECTRIC SIGNAL FOR RAILWAYS; E. B. Cutten, New York, and A. C. Fraser, Brooklyn, N. Y. App. filed Feb. 6, 1891. A normally closed circuit carried by the locomotive and fed by a generator with a predetermined normal current, combined with a danger magnet uninfluenced by the normal current but responding to a certain increase of current to give the danger signal.

721,194. ELECTRIC SWITCH; A. W. Horn, Buffalo, N. Y. App. filed April 7, 1902. A drum is provided with sockets in which pins are removably placed, said pins being arranged to contact with circuit closing fingers to operate sign lamps.

721,202. FACSIMILE TELEGRAPH; E. E. Kleinschmidt, New York, N. Y. App. filed Feb. 7, 1900. Improvements in the various features of a facsimile system.

721,205. ELECTRIC TIME SWITCH; A. W. Lauter, Sr., Chattanooga, Tenn. App. filed May 26, 1902. (See Current News and Notes.)

721,217. FUSE BOX; J. K. Morgan, Baltimore, Md. App. filed April 7, 1902. Details of a magazine fuse-box.

721,229. MOTOR; O. H. Pieper and A. F. Pieper, Rochester, N. Y. App. filed Sept. 20, 1901. An alternating-current motor in which the speed is controlled by the employment of an induction winding in shunt with the armature brushes, regulation being accomplished by varying the turns on the inductive winding.

721,270. ELECTRIC HAND OR FOOT HEATER; A. Zeckendorf, Cincinnati, O. App. filed Dec. 22, 1902. A mitten or slipper having a heating resistance wire threaded through the fabric.

721,273. CIRCUIT BREAKER; H. P. Ball, New York, N. Y. App. filed Jan. 29, 1902. The circuit breaker is provided with two independent means for actuating it, one of which is adjustable as to sensitiveness without permanently altering its normal calibration.

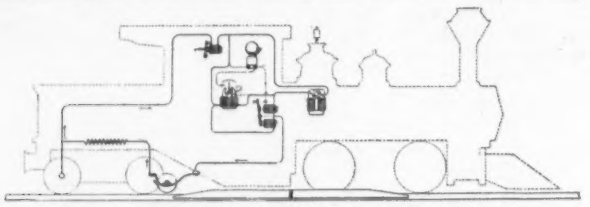
721,289. TRANSFORMER; O. J. Depp and J. P. Hunter, Dallas, Tex. App. filed June 30, 1902. The slit in the iron sleeve surrounding the core is plugged up with fibre to prevent its edges from being closed by the tension of the winding.

721,372. ELECTRIC CONTROLLER; J. H. Holland, Columbus, O. App. filed June 23, 1902. A reversing switch, a switch lever, a controller and its lever and a device carried by one lever for automatically engaging the other, so that both will move together a limited distance.

721,387. HEATER CUT-OUT FOR ELECTRIC LAMPS; H. N. Potter, Göttingen, Germany. App. filed Sept. 2, 1899. The contacts of the cut-out are controlled by energy derived from the heat of the ballast, all being closed in a sealed chamber.

721,402. ELECTROPLATING APPARATUS; J. Walters, Sumter, S. C. App. filed March 22, 1902. (See Current News and Notes.)

721,410. SWITCH FOR ELECTRIC CIRCUITS; J. J. Wood, Fort Wayne, Ind. App. filed June 23, 1901. A circuit closing lever pivoted in the middle, is connected by means of a link with an armature common to two magnets in



721,161.—Electric Signal for Railways.

such manner that one magnet will throw the lever in one direction while the other will throw it in the opposite direction.

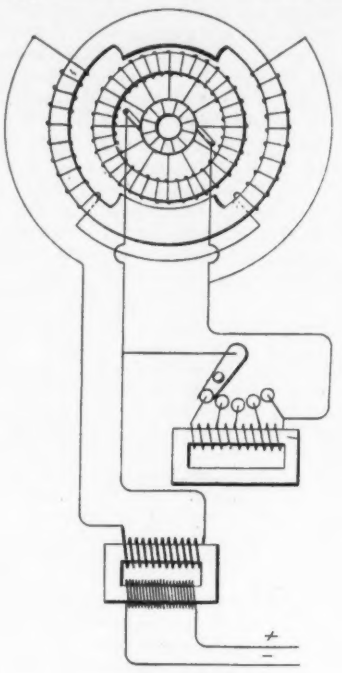
721,416. STREET RAILWAY SWITCH; W. J. Bell, Los Angeles, Cal. App. filed July 14, 1902. A lever through which the switch is moved is normally inactive to throw the switch, but electrical devices provide a fulcrum for the lever to render it active.

721,427. COUPLING FOR CONVERTERS OR RODS FOR PURPOSES OF UNDERGROUND CONDUITS; T. J. Cope, Philadelphia, Pa. App. filed May 16, 1902. Details.

721,451. THERMOSTAT; J. M. Latimer, Philadelphia, Pa. App. filed July 27, 1901. A spring contact is held out of engagement with its mate by fusible material.

721,481. SAFETY DEVICE FOR HOISTS; S. S. Wales, Munhall, Pa. App. filed Oct. 9, 1902. The device is applied to any shaft of the hoisting machine and embodies a reducing gear which causes a cut-out to be operated when the hoist reaches the end of its movement in either direction.

721,490. ELECTROMAGNET FOR SEPARATING METALS; G. H. Young. Elmira, N. Y. App. filed Feb. 12, 1902. A horse shoe magnet in which the



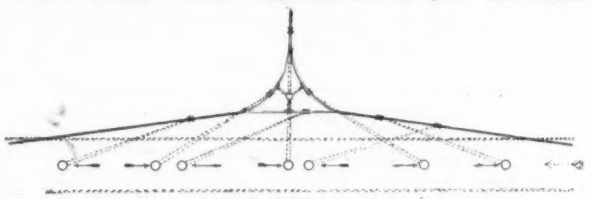
721,229.—Motor.

back-yoke serves as a handle for manipulating it and a push button is conveniently located on the end of one spool.

721,520. FIRE ALARM SYSTEM; B. P. Ketcham, Carthage, N. Y. App. filed March 13, 1902. Details.

721,529. TROLLEY POLE REVERSER FOR ELECTRIC TRAMWAYS; F. E. Ward, Cheltenham, Eng. App. filed Dec. 22, 1902. A branch or shunt from the main wire is formed with a V-shaped, upwardly pointing track on to which the trolley wheel runs and which permits the pole to occupy a vertical position when the wheel reaches the apex of the track, so that the car can then move in either direction and the pole will automatically incline to the rear.

721,559. BINDING SCREW FOR ELECTRICAL CONNECTIONS; G. W. Goodridge, Bridgeport, Conn. App. filed Dec. 2, 1902. The washer under



721,529.—Trolley Pole Reverser for Electric Tramways.

the head of the screw is carried upward with the screw to save the trouble of lifting it with the finger or the point of a screw driver in order to place the wire beneath it.

721,602. HEATER CUT-OUT FOR ELECTRIC LAMPS; H. N. Potter, Göttingen, Germany. App. filed Aug. 9, 1899. The expansion of the ballast wire is made use of to operate a circuit-breaker through which the circuit to the heater is closed when the glower is not in operation.

721,646. ELECTRIC HEADLIGHT; J. Kirby, Jr., Dayton, O. App. filed Dec. 26, 1901. Improvements in construction whereby the size of the lamp is reduced and its cost lessened. Auxiliary means are also provided for establishing the circuit in the event of the failure of the current to perform this function.